Co-funded by the European Union
Project: 2023-2-BG01-KA210-SCH-000185374

DIGITAL TOOLKIT

Research on the best European secondary school practices in engaging girls in STEM education to develop skills in accelerating the green transition

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INTRODUCTION

WHY WOMEN IN GREEN?

The shift to a green economy will result in the loss of an estimated 6 million jobs, particularly in fossil fuel sectors. However, the International Labor Organization ("https://www.ilo.org/ankara/news/WCMS_629605/lang--en/index.htm") (ILO) estimates that 24 million new jobs could be created globally by the year 2030, assuming that the right mix of policies and programs are implemented. Experts say that green jobs – defined by the ILO as "jobs that contribute to preserving or restoring the environment" – are growing fastest in the energy, agriculture, transportation, construction, and manufacturing sectors. This represents a gateway for many women, who have historically been underpaid and undervalued in the labor market and under-represented in technical and leadership roles.

In December 2019, the European Commission adopted the European Green Deal[1]- a growth strategy with the overarching goal of making Europe climate-neutral by 2050 and transforming the EU into an equitable and prosperous society where no one is left behind. Alongside climate as the main focus, the EU action to deliver the European Green Deal includes energy, environment and oceans, agriculture, transport, industry, research and innovation, finance, and regional development.[2]

In March 2020, the European Commission adopted the EU gender equality strategy[3] presenting policy objectives and initiatives to make significant progress towards a gender-equal Europe by 2025. One of its key objectives is to achieve gender balance in decision-making and in politics (with a representation of at least 40 % of each sex), which is a precondition for a properly functioning democracy and crucial for a successful leadership that can solve complex challenges.

1 Commission communication – The European Green Deal, COM(2019) 640 final, https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF..

2 These eight areas have been identified based on the areas displayed in the European Green Deal landing page, https://commission.europa.eu/strategy-and-policy/ priorities-2019-2024/european-green-deal_en.

3 Commission communication – A Union of equality: Gender equality strategy 2020–2025, COM(2020) 152 final, https://eur-lex.europa.eu/legal-content/EN/ TXT/?uri=CELEX%3A52020DC0152.

WHY WOMEN IN STEM?

In today's rapidly evolving world, science, technology, engineering, and mathematics (STEM) fields play a pivotal role in shaping our future. As we strive to achieve the United Nations Sustainable Development Goals (SDGs), it is essential to recognize the indispensable contributions of women in STEM to attain these global objectives.

In 2023, the gender gap in STEM remains significant, with women making up only 28% of the STEM workforce according to statistics. The figure stands at 24% in the United States, 17% in the European Union, 16% in Japan, and 14% in India. Despite progress in gender equity and growing interest over the last decade in computer science, engineering, math, and statistics among both men and women, the underrepresentation of women in the Science, Technology, Engineering, and Mathematics (STEM) fields continues to persist. In 2023, the gender gap in STEM remains

Figure 1

"Biggest threat to gender equality is a myth that we have achieved it," says university rector" from More women graduate in Stem but inequalities persist in EU report.

significant, with women making up only 28% of the STEM workforce.

There has been a slight increase in the share of female graduates in science, technology,t engineering, and mathematics subjects in the EU, but gender inequalities in STEM persist.

In 2021, women accounted for 32.8 percent of all EU university, college, and trade school graduates in STEM, up from 32.5 percent in 2020, the statistics agency Eurostat revealed on 8 March, which was International Women's Day.

Romania, Poland, and Greece had the highest shares of female graduates in STEM, all over 40 percent, while Belgium, Spain, and Germany had the lowest shares, all below 30 percent. The underrepresentation of women in STEM is a longstanding issue that the EU has been attempting to address, including through its European Research Area policy package.

The European Commission highlighted the ongoing gap between male and female graduates in STEM fields in a report on gender equality in the EU, released on March 8th. The report emphasized that gender stereotypes limit choices in life, education, and employment, perpetuating unequal power dynamics between genders. Despite there being more female university graduates in the EU overall, the proportion of women in STEM fields, which offer better pay and career opportunities, remains consistently lower than men. A notable example is that men constitute 80 percent of graduates in ICT. Katharina Holzinger, the University rector, warned against the misconception that gender equality has already been achieved, labeling it as the greatest obstacle to progress.

STEM education can play a crucial role in promoting green skills by integrating environmental awareness, sustainability principles, and practical applications into its curriculum. By emphasizing topics such as renewable energy, conservation, climate change mitigation, and ecological design, STEM programs can empower students with the knowledge and skills needed to address environmental challenges.

Through hands-on experiments, projects, and real-world applications, students can develop a deep understanding of environmental issues and the scientific principles underlying sustainable solutions. Additionally, incorporating interdisciplinary approaches that blend STEM disciplines with environmental studies can provide students with a holistic understanding of complex environmental issues and foster innovative thinking.

Furthermore, partnerships with industry, research institutions, and environmental organizations can offer students opportunities for experiential learning, internships, and mentorship, enabling them to apply their STEM knowledge to real-world environmental challenges. By equipping students with green skills, STEM education can prepare the next generation of leaders, innovators, and problem-solvers to create a more sustainable future.

To promote green skills among girls in secondary education through STEM, targeted initiatives and approaches can be implemented:

- Inclusive Curriculum: to develop STEM curricula that explicitly integrate environmental education and sustainability concepts. Ensure that these curricula highlight the relevance of green skills in addressing global environmental challenges.
- Hands-On Learning: to provide hands-on, experiential learning opportunities that engage girls in practical activities related to environmental science, renewable energy, conservation, and sustainable development. This approach can help girls develop a deeper understanding of green concepts and their applications.
- Role Models and Mentorship: to foster mentorship programs and invite female role models from STEM fields, particularly those working in environmental science and sustainability, to inspire and mentor girls. Exposure to successful women in these fields can help girls envision themselves pursuing careers in STEM-related environmental fields.
- Project-Based Learning: to implement project-based learning approaches where girls can work collaboratively on green-focused projects. Encourage them to identify local environmental issues and develop innovative solutions using STEM principles.

• Community Engagement: to facilitate partnerships with local environmental organizations, NGOs, and industry partners to provide girls with opportunities for community-based projects and environmental initiatives. This can help girls see the real-world impact of their STEM skills on environmental conservation efforts.

• Equitable Access: to ensure equitable access to resources, facilities, and extracurricular activities related to STEM and environmental education. Address barriers such as stereotypes, bias, and lack of representation to create an inclusive learning environment where girls feel supported and encouraged to pursue green skills.

• Career Awareness: to offer career exploration activities, workshops, and guest lectures focused on green careers in STEM fields. Highlight diverse career paths in environmental science, engineering, technology, and policy to inspire girls to pursue further education and careers in these areas.

By implementing these strategies, secondary education institutions can empower girls to develop green skills through STEM education, preparing them to become future leaders and innovators in environmental sustainability.

1. LANDSCAPE MAPPING

1.1 DRIVING NEEDS AND ASPIRATIONS

Education, as the structured method of imparting knowledge and skills throughout life, has been fundamental in transforming human societies. It links us to the world and to each other, opens new opportunities, and enhances our abilities for dialogue and action (UNESCO 2021).

On a personal level, education is vital for personal and societal development. It equips individuals with essential skills, knowledge, and attitudes for personal growth, career advancement, and socio-economic mobility (OECD 2022). Education fosters literacy and numeracy, critical thinking, problem-solving, communication, teamwork, and social and emotional skills essential for personal success (OECD 2019). Furthermore, education encourages civic engagement, democratic participation, and social inclusion, while also promoting cultural awareness, tolerance, and understanding.

On a societal level, education drives economic growth, social development, and peace and stability. It boosts economic growth by providing individuals with the skills and knowledge needed for innovation, entrepreneurship, and job creation (World Bank 2011). Education also helps reduce poverty and inequality by offering opportunities for socio-economic mobility and social protection (OECD 2019). Additionally, education fosters social cohesion and stability by enhancing civic engagement, democratic participation, and peaceful conflict resolution (UNESCO 2021).

Education is vital for equipping students with the skills needed to succeed in 21st-century societies. STEM education, in particular, is a crucial component of modern learning, preparing students for the increasing demand for STEM careers in the global economy. It imparts knowledge and skills in science, technology, engineering, and mathematics, essential for innovation, economic growth, and societal development. Additionally, STEM education enhances critical thinking, problem-solving, creativity, and communication skills, which are crucial for tackling complex societal issues like climate change, energy security, and public health (Nguyen et al., 2020).

STEM education also promotes gender equality and social inclusion by providing opportunities for underrepresented groups. Women, girls, persons with disabilities, and individuals from low-income and minority backgrounds are often underrepresented in STEM fields and careers. STEM education can address this disparity by creating inclusive and equitable learning environments that foster diversity, equity, and inclusion (OECD 2022).

High-quality STEM education involves several key aspects:

• Teachers: Well-trained, motivated, and adequately compensated teachers are essential for delivering quality education.

• Curriculum: The curriculum should be tailored to meet student needs and job market demands, regularly updated to reflect societal and economic changes.

• Infrastructure: Adequate facilities, such as classrooms, libraries, and laboratories, are necessary for a robust education system, requiring government investment.

• Technology: Investing in technology, including computers, tablets, and internet access, can enhance education quality and learning outcomes.

• Access to education: Education should be accessible to everyone, regardless of socioeconomic status or location, necessitating government efforts to reach rural and remote areas.

• Support services: Services like counselling and mentoring are crucial for student success and should be adequately funded.

• Funding: Sufficient funding is essential for maintaining high-quality, accessible education for all.

Advancing these aspects requires collaboration among educational stakeholders. Open schooling embodies this principle by facilitating cooperation among educators, learners, parents, industry professionals, and policymakers. It promotes an open, inclusive learning environment that encourages exploration of new ideas, exposure to real-world problems, and innovative problem-solving. By bringing together diverse stakeholders, open schooling fosters new partnerships and creates a dynamic, engaging learning atmosphere (Hazelkom et al., 2015).

1.2 POLICY CONTEXT / EUROPEAN COMMISSION HIGHLIGHTS

Global societies are becoming increasingly interconnected and interdependent while simultaneously competing more intensely to acquire scientific knowledge and technological skills. This expertise is crucial for generating new opportunities and innovative solutions to tackle complex societal issues. To navigate these challenges effectively, it is essential for all citizens to have a strong understanding of science and technology, enabling them to engage actively and responsibly in science-informed decision-making and knowledge-based innovation. Therefore, science education policies are crucial as they serve as a pivotal tool for achieving long-term economic growth and societal prosperity. Over the past decades in Europe, there has been a decline in the number of students interested in or pursuing careers in science and technology. Despite some progress, a significant gender gap persists in STEM fields. Additionally, there has been no substantial increase in science-based innovation or advanced knowledge-based entrepreneurship. Consequently, Europe is experiencing a shortage of scientifically knowledgeable individuals across all sectors of society and the economy. To address these challenges, a strong and coordinated effort is needed to support education and training systems in Europe. In response, the EU introduced the renewed Digital Education Action Plan to promote the sustainable and effective adaptation of education and training systems in EU Member States to the digital age (EC 2020). Furthermore, gender equality remains a key policy priority, with a particular emphasis on increasing women's participation in STEM disciplines and professions, as highlighted in the action plan. The importance of gender equality is also emphasized in the Education 2030 Agenda, which views education as a means to empower all genders (UNESCO 2016). The UN Sustainable Development Goals also promote making mainstream education more inclusive, equal, and diverse, particularly through Goal 4: "Ensure inclusive education and promote lifelong learning opportunities for all" (UN 2015).

In 2015, the European Commission's expert group on science education published the "Science Education for Responsible Citizenship" report, emphasizing the need for reform in science education policy. The report highlights the importance of equipping all citizens with the knowledge and skills to participate actively and responsibly in society, aiming to increase industry and enterprise involvement in science education. This approach seeks to provide sustainable and competitive solutions by fostering a

responsive science education system that encourages broader participation in knowledge-based innovation. The goal is to ensure sustainable societies by aligning science education, research, and innovation with societal needs and values. Key recommendations from the report include:

- Incorporating Science Education: Science education should be part of a lifelong learning continuum, starting from preschool to promote engaged citizenship.
- Focus on Competences: Emphasize learning through science and integrate STEM with other disciplines to form STEAM, highlighting the value of interdisciplinarity in addressing societal challenges and fostering innovation.
- Enhancing Collaboration: Improve cooperation between formal, non-formal, and informal educational providers, enterprises, and civil society to increase the relevance and uptake of science studies and careers.
- Fostering Partnerships: Promote networking and sharing of science and technology research among teachers, researchers, and professionals across various enterprises to enhance learning and innovation capacity for all involved.
- These strategies aim to nurture curiosity and cognitive skills in young learners, better preparing future scientists, researchers, engineers, and other stakeholders to engage in the innovation process with a strong sense of societal responsibility.

European recent highlights and documents

European Green Deal (2019 – 2024): It aims to turn the EU into the first climate-neutral continent by 2050. To achieve this goal, EU member states committed to reducing emissions by at least 55% by 2030, compared to the 1990 level.

("https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en")

Council recommendation on learning for environmental sustainability (14 January 2022): The recommendation **aims to support the Member States in equipping learners with knowledge, skills, and attitudes to be able to act on sustainability**, climate change, and biodiversity.

("https://green-comp.eu/wp-content/uploads/2022/02/proposal-council-recommendation-learning-environmental-sustainability_0.pdf")

New competence framework to support learning for environmental sustainability:

Linked to the **Council Recommendation on learning for the environment the Commission** published a new **competence framework on sustainability for lifelong learning** (GreenComp) that provides learners and educators a common grid on what sustainability entails as a competence. **EARLALL was involved in the validation of the framework** as the organisation was **part of the Stakeholders' expert group.**

("https://green-comp.eu/wp-content/uploads/2022/02/jrc128040_greencomp_f2.pdf")

European Green Deal 2050: The European Green Deal is a package of policy initiatives, which aims to set the EU on the path to a **green transition**, with the ultimate goal of reaching climate neutrality by **2050.**

("https://www.consilium.europa.eu/en/policies/green-deal/")

European Education Area: The EU is encouraging the education and training sector to take action to contribute to the green transition and to strengthen the sustainability competences of all learners. European expert groups were formed at European level to support the green education and training based on the following decisions:

- Council resolution on a strategic framework for European cooperation in education and training

1.3 EUROPEAN WORKING GROUP ON SCHOOLS

This Working Group aims to promote better achievements in basic skills and the successful completion of education and training pathways by all learners; education for the green transition; and enhancing competence and motivation in the education profession

The Working Group consists of 2 sub-groups:

1.4 PATHWAYS TO SCHOOL SUCCESS

It will support the implementation and follow-up of the forthcoming Council Recommendation on Pathways to School Success by promoting mutual learning and exchanging best practices, including issues related to well-being at school."

1.5 LEARNING FOR SUSTAINABILITY

Will support the follow-up to the Council Recommendation on education for environmental sustainability and will promote mutual learning and exchange on how education can support the move to a greener and more sustainable Europe, including the development of sustainability competences.

Documents, deliverables, meetings, and minutes for Schools Working Groups

("https://wikis.ec.europa.eu/display/EAC/Schools")

Useful facts:

Fewer women are interested in participating in the digital sector, be it in the field of higher education, jobs, or entrepreneurship. The Commission study 'She Figures' (2021) confirms this trend. According to the study, women represent only 20% of Information and Communications Technology (ICT) graduates, and only 17% hold tech sector jobs. Women also represent only 24% of self-employed professionals in technical professions, such as science, engineering, or ICT.

Young girls and boys are almost equally able to expect to work in a science-related field, but with age and at higher levels of education, girls tend to steer away from Science Technology Engineering Mathematics (STEM), and ICT subjects. Available data ('Women in the digital age', 2018) shows that only one in three STEM graduates is a woman.

There has been a small increase of female scientists and engineers in EU Member States, with 39% in 2011 rising to 41% in 2020.

The European Digital Education Plan (https://education.ec.europa.eu/focus-topics/digital-education/action-plan/action-13) recommends the following actions:

To encourage women's participation in STEM studies and careers and ensure enhanced inclusion of women in the digital economy, the European Commission will support young female students in developing their digital and entrepreneurship competences.

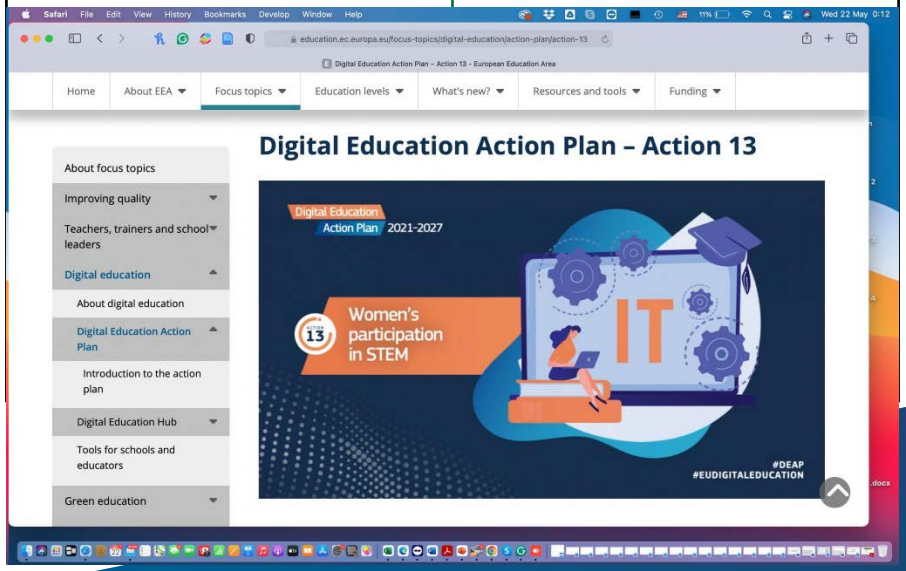
It will seek to increase the inclusion of women in digital and STEM study fields and careers, including as entrepreneurs.

DIGITAL EDUCATION ACTION PLAN – ACTION 13

- Promoting Open Schooling: Encourage schools to collaborate with families, local communities, and professionals to bring real-life projects into the classroom, fostering community well-being and practical engagement with science.
- Commission communication on achieving the European Education Area by 2025

Key activities

- Make training in digital and sustainable entrepreneurship competences available to girls at the secondary education level via the dedicated online learning platform Girls Go Circular (managed by EIT RawMaterials, a Knowledge Innovation Community of the European Institute of Innovation and Technology) ("https://eit.europa.eu/our-communities/eit-innovation-communities")



• Organise girl's and women's E-STEAM* festivals in different EU Member States to enhance digital and entrepreneurial competences among girls and women and boost their confidence to use them creatively to spot opportunities, innovate and create value for society ("https://eismea.ec.europa.eu/news/empowering-women-and-girls-through-digital-and-entrepreneurial-competences-esteam-fests-and-2022-03-07_en")

• Offer new higher education programs for engineering and information and communications technology based on the interdisciplinary STEAM approach. This includes building on the EU STEM Coalition to support the establishment of national STEM platforms and disseminating the results of Erasmus+-funded projects and good practices available within the European Universities alliances .("https://education.ec.europa.eu/node/1525"")

Expected results/deliverables

• By the end of 2027 - engage 40,000 young female students in training on the circular economy and digital skills

• Include STEM as a priority in the 2021 and 2022 Erasmus + annual work program for the Cooperation Partnerships projects in the field of higher education

Related links

Digital Education Action Plan

("https://ec.europa.eu/education/node/1518")

EUDigitalEducation on Twitter

("https://ec.europa.eu/education/node/1518")

"There is a need to encourage young girls to engage in future occupations and to take part in the jobs that will build our future society. In 2014, the European Commission predicted that Europe could face a shortage of up to 900,000 skilled information and communication technology workers by 2020. In 2017, they adjusted this to a deficit of 500,000."

("https://www.cbi.eu/market-information/outsourcing-itobpo/software-development-services/market-potential")

"This gender gap may be a brake on the digital transformation that the European Commission wants to achieve. It will be hard to build an ICT-friendly Europe if the opportunities for learning and development do not include everyone, especially women."

("https://digital-strategy.ec.europa.eu/en/policies/digital-skills-and-jobs")

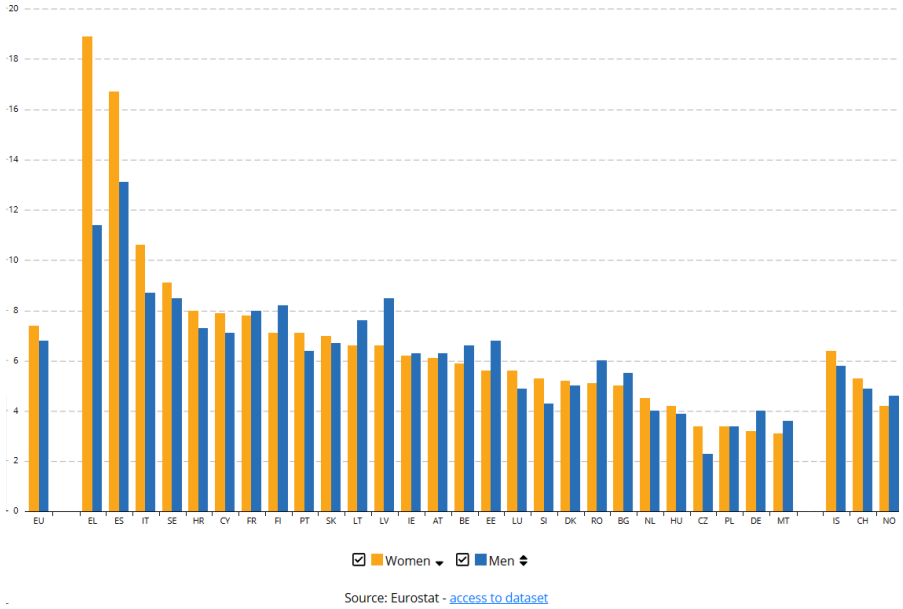


Figure 2

In 2022, in the EU there were 6.7 million unemployed men and slightly fewer unemployed women, amounting to 6.5 million. Despite the lower number of unemployed women, they represented 6.5 % of the female labour force, whereas unemployed men accounted for a lower percentage - at 5.9 % - of the male labour force.

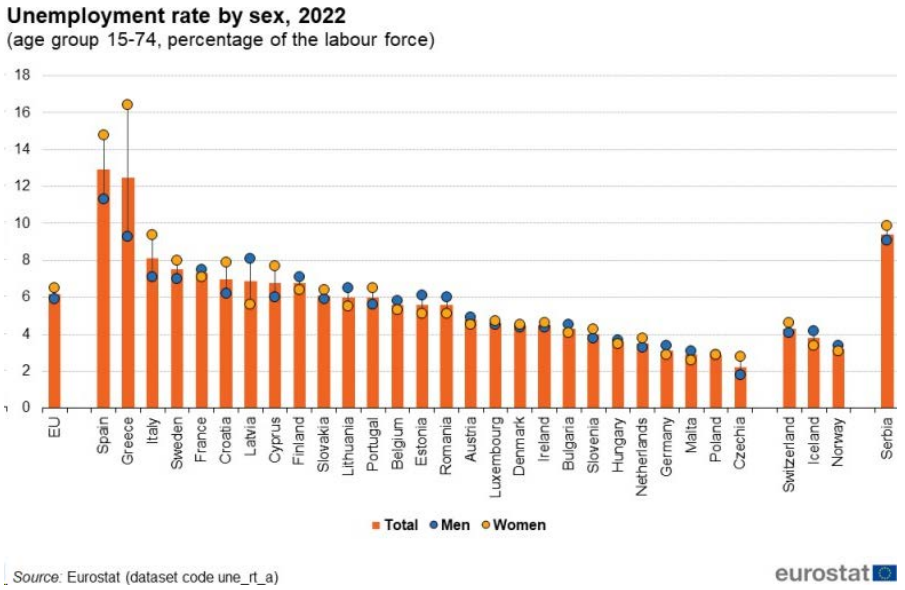


Figure 3

For example, according to Eurostat from 2021, only 35% of managers in the EU were women, while 5.2% more women took part in tertiary education.

Among the factors contributing to the under-representation of women and girls in STEM, the sector notably lacks female figures in the field. Role models can inspire and reduce self-stereotypes of stigmatised groups, which may be the case for women in male-dominated STEM fields.

("https://www.frontiersin.org/articles/10.3389/fpsyg.2020.02204/full")

"*We, humans, learn by example, so by providing access to these role models with their personal stories and struggles, we offer girls a great insight on what their future in STEM can be. As we often say, if you can see something, then you can become it*", added **Evita Tasiopoulou, STEM Project and Pedagogical Manager at European Schoolnet**.

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("https://www.frontiersin.org/articles/10.3389/fpsyg.2020.02204/full")

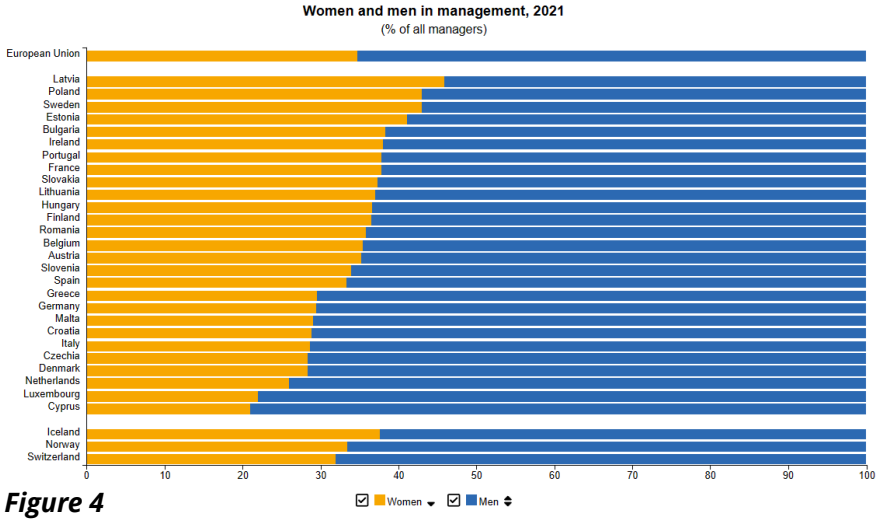


Figure 4

Source: Eurostat - access to dataset

The figure above indicates that the youth unemployment ratio in the EU stood at 6.3 % for the year 2022, indicating the proportion of unemployed people aged 15-29 years within the total population of the same age. If we take as a denominator only those young people participating in the labour force, we reach a youth unemployment rate of 11.3 %. For comparison, unemployed people aged 30-74 years represented 3.4 % of the total population and 5.0 % of the labour force of the same age group.

Across the EU Member States, the youth unemployment ratio varied from 2.0 % in Czechia to 11.2 % in Spain, while the youth unemployment rate ranged from 4.2 % in Czechia to 24.3 % in Greece.

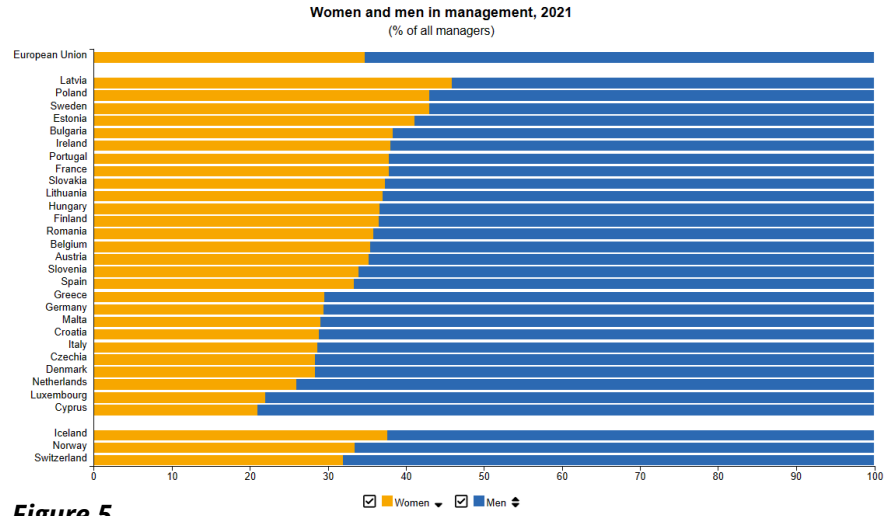


Figure 5

Source: Eurostat - access to dataset

Closing the gender gap in STEM could lead to an additional 1.2 million jobs. Closing gender gaps in STEM education would have a positive impact on employment. Total EU employment would rise by 850 000 to 1 200 000 by 2050.

These jobs are forecasted mostly in the long term, as employment rates will rise only after more women studying STEM finish their education.

The new jobs are likely to be highly productive because women graduating from STEM often progress into high-added-value positions in sectors such as information and communication or financial and business services.

A larger STEM workforce pool is expected to be more productive, to boost the potential productive capacity of the economy, and to generate an increase in GDP per capita.

Higher productivity in STEM jobs is likely to result in higher wages (European Parliament, 2015). Remarkably, the study shows a closure of the gender wage gap by 2050. There is an increase in the number of women graduating in STEM subjects and, because of their higher educational attainment and choice of career in higher-wage sectors, women experience a gradual increase in average earnings, reaching parity with wages for men by 2050.

Increasing the participation of women in STEM subjects will have a strong positive GDP impact at the EU level. Closing the gender gap in STEM would contribute to an increase in EU GDP per capita by 0.7-0.9 % in 2030. By 2050, the increase is between 2.2 % and 3.0 %. In monetary terms, closing the STEM gap leads to an improvement in GDP by EUR 610-820 billion in 2050.

According to ILO when companies are gender-balanced companies are 20% more likely to have enhanced business outcomes.

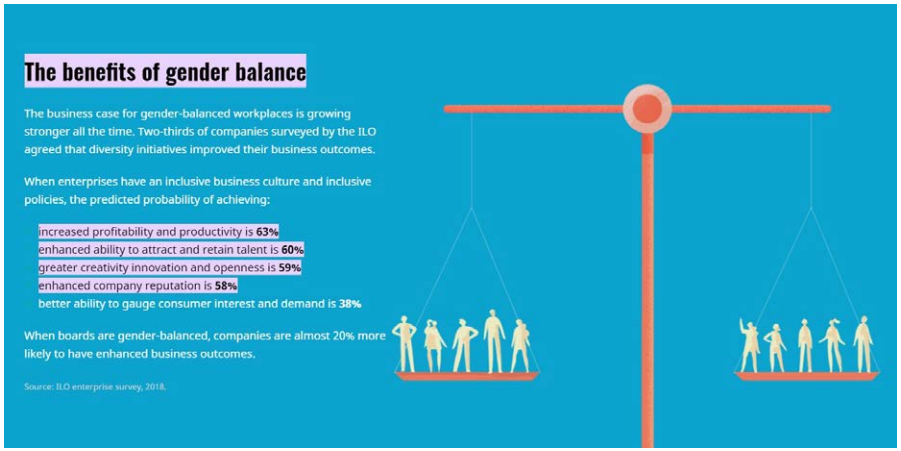


Figure 6

Among the EU countries, the proportion of female scientists and engineers varied widely in 2022, ranging from 53% in Denmark, Lithuania (52%) and Bulgaria (51%) to 31% in Hungary, Finland (32%) and Germany (34%) according to Eurostat.

Figure 7

2. GIRLSGOGREEN PROJECT OBJECTIVES RELATED TO RESEARCH

2.1 GIRLSGOGREEN(GGG) GENERAL OBJECTIVE

GGG aims to empower secondary education (SE) girls with green skills through innovative challenge-based learning strategies and engage them in sustainability practices. It promotes the Integrated - Science, Technology, Engineering and Math (I-STEM) approach to SE teachers in STEM disciplines as an interdisciplinary teaching method in environmental and Circular Economy (CE) contexts, particularly focusing on raising the girls' interest in STEM. It has been estimated that the CE will create 700,000 new jobs in the EU by 2030 (Cambridge Econometrics, Trinomics and ICF 2018). Engineers and STEM professionals are the frontrunners of new technological development and innovation, and, therefore, it is assumed that the transition to a CE will increase the demand for new skills within engineering and the general STEM sector where women are underrepresented.

2.2 CONCRETE OBJECTIVES ARE AS FOLLOWS:

1. Exploit and share best European SE practices in engaging SE girls in STEM education with a focus on green skills;

2. Empower 10 SE STEM teachers with new knowledge and skills in I-STEM teaching within the environmental and CE context;

3. Raise the STEM interest and awareness of CE in 60 secondary school girls from 2 EU schools and one informal girls' group through the pilot of GGG's new tool as an informal educational activity;

4. Provide valuable feedback for EU career guidance to 60 EU SE girls;

5. Establish a European network of GGG ambassadors between secondary schools, local communities, and businesses

6. through organising 3 Multiplier events Girls Go Green in PPC;

2.3 THE MAIN PROJECT RESULTS WILL BE:

- 60 SE girls will be enforced with green job skills and STEM knowledge,

- 10 SE teachers and educators empowered with new pedagogical skills in STEM for green jobs,

- 3 national education green jobs policies towards gender balance proposed,

- GGG organisations - empowered with new strategies and tools to support SE girls in green and STEM education,

- EU Secondary Education with new tools and strategy in STEM for GREEN skills for girls;

To successfully reach its project objectives the GGG partnership foresees research on the best European secondary school practices in engaging girls in STEM education for the development of skills in accelerating the green transition; This activity will be implemented following the below-mentioned steps.

A1.The partnership will conduct a desk review on the best European secondary school practices in engaging girls in STEM education for development of skills in accelerating the green transition, such as STEM, green and Circular Economy skills.

The study will include searching in EU platforms School Education Gateway, EPALE, and the EU Learning Corner including teaching and learning materials on sustainability and the climate and environmental crisis for secondary schools. Also, the 2022 European Innovative Teaching Award selected 50 outstanding projects focused on sustainability in schools will be included. Interproject coaching will be carried out on successfully funded projects in that domain. European successful projects like Girls Go Circular, Greenland and others will be included as interproject coaching activity realted to the GGG research. Their open results will be taken into consideration as good practices.

A2. The project Steering Committee will elaborate on the criteria of "what best practice is"

in that relation through online communication and a Zoom meeting. The 10 most suitable practices according to the agreed criteria will be selected in both categories of research.

A3. A draft version of 1 digital toolkit including a minimum of 10 practices in secondary school practices in engaging girls in STEM education for the development of skills in accelerating the green transition will be elaborated by the participating project researchers and presented to SC.

A4. A Steering Committee online meeting will be organised and the draft version will be presented and discussed.

A5. The final version of the digital toolkit will be elaborated and uploaded as open source on the websites of partners on 30 th of June 2024.

3. THE EUROPEAN SETTING - SECONDARY SCHOOLS

According to the World Bank, women's labor force participation sits at just over 50 percent, far below that of men at 80 percent. The global pandemic widened this gap, and it will now take another 132 years to ("https://www.abtglobal.com/insights/perspectives-blog/empowering-women-as-change-agents-in-the-green-economy") achieve gender equality. An often-quoted report (""https://www.mckinsey.com/%7E/media/mckinsey/industries/public%20and%20social%20sector/our%20insights/how%20advancing%20womens%20equality%20can%20add%2012%20trillion%20to%20global%20growth/mgi%20power%20of%20parity_executive%20summary_september%202015.pdf"") notes that if gender gaps at work are bridged and women participate in the economy identically to men, approximately $28 trillion would be added to the annual global GDP in 2025.

3.1 GIRLS' AND WOMEN'S EDUCATION IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM)

According to UNESCO ("https://www.unesco.org/en/gender-equality/education/stem") more girls are in school today than ever before, but they do not always have the same opportunities as boys to complete and benefit from an education of their choice. UNESCO also believes that having more women in STEM fields is desirable because it would help bring about sustainable development.

Too many girls and women are held back by biases, social norms, and expectations influencing the quality of the education they receive and the subjects they study. They are particularly under-represented at the world scale in science, technology, engineering, and mathematics (STEM) education - women make up only 35% of STEM graduates, a figure unchanged in ten years - and consequently, in STEM careers.

UNESCO produced a cutting-edge global report entitled Cracking the Code: Girls' and Women's Education in Science, technology, engineering and mathematics (STEM) 2017, mapping the status of girls and women in STEM education and identifying the factors hindering and promoting their participation, achievement, and continuation in STEM fields. This report is the first to document the drivers of gender disparity in STEM studies globally. Through this comprehensive research exercise, UNESCO has built a strong knowledge base on the gender gap in STEM education and provided evidence-based policy recommendations to education ministries and relevant stakeholders.

This gender disparity is alarming, especially as STEM careers are often referred to as the

jobs of the future, driving innovation, social well-being, inclusive growth, and sustainable development. UNESCO is giving special attention to this issue through research, policy, and capacity-building work and as part of its efforts to promote the empowerment of girls and women through education.

UNESCO works to empower girls and women in acquiring basic competences and digital skills to help close the gender digital divide. Through financial support from Intel, Prada, and other partners, UNESCO is enhancing girls' digital skills for learning.

Role models and mentors are particularly effective in tackling gender bias. They offer girls an authentic understanding of STEM studies and careers and show them they can become who they dream of being. According to Irina Bokova, UNESCO Director General, in her Opening Remarks

"Far too few girls are in school and studying science. Even fewer go on to lead science careers. Such deep inequality doesn't happen by chance. It is the result of a wide range of factors, starting with social, cultural, and gender norms that influence how girls and boys are brought up, how they learn and interact with family, friends, teachers, and the wider community, which shape their identity, behavior and choices. ... To tackle the STEM crisis, we must, first, understand it... This is why this High is so important, to share experience, to launch new avenues of action and cooperation." The UNESCO report states "Despite notable advancements in recent years, education remains unevenly accessible, and gender disparities persist. Many countries face challenges in getting girls into school and struggle to provide diverse educational opportunities for those who attend. Of particular concern is the issue of lower participation and achievement levels of girls in STEM (science, technology, engineering, and mathematics) education. STEM education is essential for advancing the goals outlined in the 2030 Agenda for Sustainable Development, as it equips learners with the knowledge, skills, attitudes, and behaviors necessary for creating inclusive and sustainable societies. Excluding girls and women from STEM education and careers deprives society of valuable contributions. This report seeks to uncover the factors that hinder or facilitate girls' and women's involvement in STEM education and suggests actions that the education sector can take to encourage their interest and engagement in STEM fields. Gender disparities in STEM education start early, becoming increasingly apparent from early childhood education and continuing through higher levels of schooling. As girls progress through education, their interest in STEM subjects tends to diminish, resulting in lower participation rates, particularly at the secondary and tertiary levels. Women make up only 35% of students enrolled in STEM-related fields in higher education. Disparities also exist within STEM disciplines, with the lowest female enrollment rates observed in information technology, engineering, manufacturing, construction, natural sciences, mathematics, and statistics. Women are more likely to leave STEM fields during their higher education studies, as they transition into the workforce, and even throughout their careers. Cross-national studies of learning achievement from over 120 countries carried out by UNESCO show a complex landscape. While data gaps that disadvantage girls are narrowing in middle- to high-income countries, particularly in science, significant regional variations persist. In some countries, girls outperform boys in science, while in others, boys have a considerable advantage. Similarly, differences in mathematics achievement favoring boys are more pronounced in certain regions, such as Latin America and sub-Saharan Africa. Discrepancies also exist between assessments measuring curriculum-based learning and those evaluating students' ability to apply knowledge and skills in different contexts. Boys tend to outperform girls in applied learning assessments in mathematics in two-thirds of the countries surveyed." Cracking the Code: Girls' and women's education in science, technology, engineering and mathematics (STEM)

According to UNESCO, there are multiple and overlapping factors that influence the girls' and women's participation, achievement, and progression in STEM studies and careers, all of which interact in complex ways, including:

- **Individual level:** biological factors that may influence individuals' abilities, skills, and behaviour such as brain structure and function, hormones, genetics, and cognitive traits like spatial and linguistic skills. It also considers psychological factors, including self-efficacy, interest, and motivation.

- **Family and peer level:** parental beliefs and expectations, parental education and socioeconomic status, and other household factors, as well as peer influences.

- **School level:** factors within the learning environment, including teachers' profile, experience, beliefs and expectations, curricula, learning materials and resources, teaching strategies and student-teacher interactions, assessment practices, and the overall school environment.

- **Societal level:** social and cultural norms related to gender equality, and gender stereotypes in the media;

SCHOOL LEVEL

Qualified teachers with specialisation in STEM can positively influence girls' performance and engagement with STEM education and their interest in pursuing STEM careers. Female STEM teachers often have stronger benefits for girls, possibly by acting as role models and by helping to dispel stereotypes about sex-based STEM ability. Teachers' beliefs, attitudes, behaviours, and interactions with students, as well as curricula and learning materials, can all play a role as well. Opportunities for real-life experiences with STEM, including hands-on practice, apprenticeships, career counseling, and mentoring can expand girls' understanding of STEM studies and professions and maintain interest. Assessment processes and tools that are gender-biased or include gender stereotypes may negatively affect girls' performance in STEM. Girls' learning outcomes in STEM can also be compromised by psychological factors such as mathematics or test anxiety [41].

The confidence of a female teacher in STEM subjects also has a strong impact on how well female students will perform in those subjects in the elementary school classroom. For example, female elementary teachers with anxiety around math will negatively affect the achievement of their female students in math. Correlations have been found between gender bias in female elementary students and their achievement in mathematics. Those who had lower achievement over time have also been found to believe that boys are inherently better at mathematics than girls.

A study by Microsoft in partnership with KRC Research[2], finds that despite the high priority that is placed on STEM in schools, efforts to expand female interest and employment in STEM and computer science are not working as well as intended. This is especially true in technology and engineering. The study was held in 2018 and states that "While the U.S. Bureau of Labor Statistics predicts that technology professionals will experience the highest growth in job numbers between now and 2030, only a fraction of girls and women are likely to pursue degrees that enable them to fulfill these new jobs."

According to the study, the main reasons for girls not going into STEM are as follows:

- Providing teachers with a more engaging and relatable STEM curriculum, such as 3D and hands-on projects, the kinds of activities that have proven to help retain girls' interest in STEM over the long haul. ("My teacher's making me build a rocket ship with some other students, so that got me interested in STEM a little bit because I like to build and create," says one middle-school girl interviewed for the study).

- Increasing the number of STEM mentors and role models – including parents – to help build young girls' confidence that they can succeed in STEM. Girls who are encouraged by their parents are twice as likely to stay in STEM, and in some areas like computer science, dads can have a greater influence on their daughters than moms, yet are less likely than mothers to talk to their daughters about STEM, the study found. ("I grew up with my mom always encouraging me to learn more, an engineer dad and a chemist grandpa, both of whom were always

1 Mullis, I. V. S., Martin, M. O. and Loveless, T. (2016). International Trends in Mathematics and Science Achievement, Curriculum and Instruction. Boston: 20 Years of TIMSS.

2 https://news.microsoft.com/features/why-do-girls-lose-interest-in-stem-new-research-has-some-answers-and-what-we-can-do-about-it/

excited to answer my questions, support and teach me," says a 27-year-old woman interviewed for the study.)

• Creating inclusive classrooms and workplaces that value female opinions. It's important to celebrate the stories of women who are in STEM right now, today. ("It'd be cool to see women in STEM careers on posters in the hall, in our history and science texts, and visit our classes," says a 14-year-old girl who is in eighth grade. "I don't know what to focus on. But my tests say I'm a good engineer and I wish I knew what that looked like in real life.")

LIST OF BEST PRACTICES IN ENGAGING SECONDARY EDUCATION IN STEM FOR GREEN SKILLS

The New European Innovation Agenda defined deep tech innovation as crucial in reaching the climate neutrality goal by 2050. Thus, greater inclusion of girls and women in STEM and ICT is critical to meet this challenge and accomplish the green and digital transition.

("https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda_en")

The New European Innovation Agenda, (https://research-and-innovation.ec.europa.eu/document/download/d31f3f18-d831-49de-9126-8b0542faa6fd_en") adopted on 5 July 2022, aims to position Europe at the forefront of the new wave of deep tech innovation and start-ups. It will help Europe to develop new technologies to address the most pressing societal challenges and to bring them on the market through innovation procurement, ("https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/new-european-innovation-agenda/innovation-procurement_en") a pivotal demand-side instrument to modernise public services with innovative solutions while boosting the growth of innovative companies in Europe. Europe wants to be where the best talent works hand in hand with the best companies and where deep tech innovation thrives and creates breakthrough innovative solutions across the continent that are deployed widely by innovation-friendly customers.

In recent years, increasing attention has been paid to the representation of women in STEM education fields: natural sciences, mathematics and statistics, information and communication technologies, engineering, manufacturing, and construction. Women are largely underrepresented in these fields.

In 2021, in the EU, ("https://ec.europa.eu/eurostat/statistics-explained/index.php?ti-

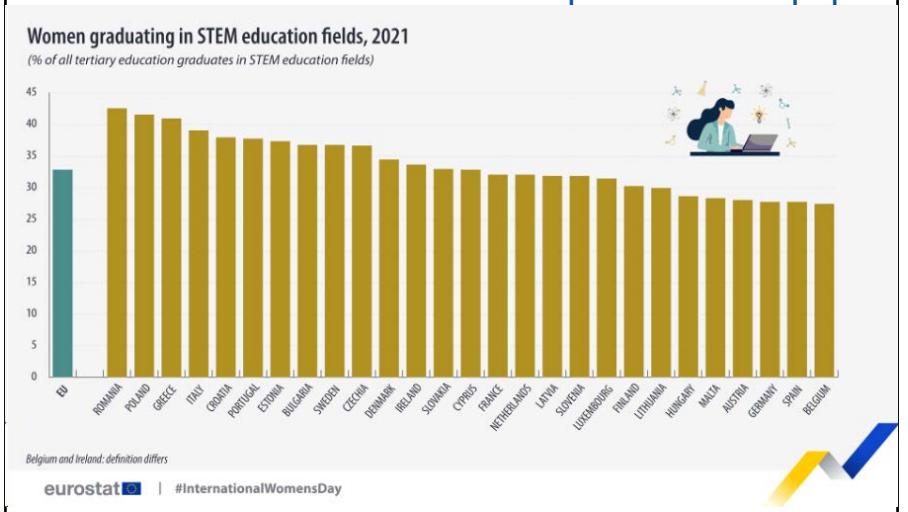


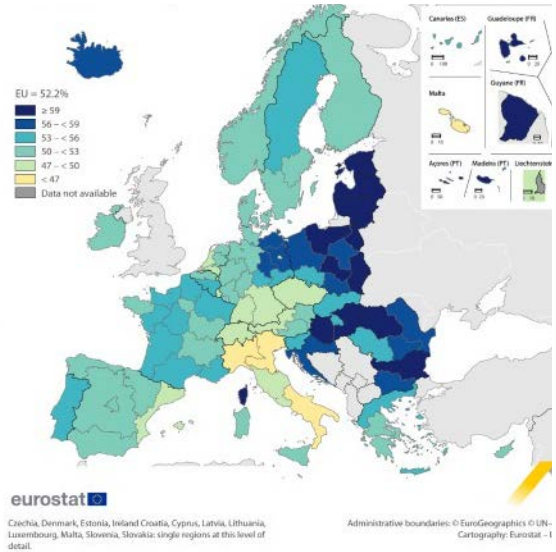
Figure 8

tle=Glossary%3AEuropean_Union_(EU)") women tertiary education graduates (International Standard Classification of Education (https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_Standard_Classification_of_Education_(ISCED)")-ISCED levels 5-8), in STEM fields, accounted for 32.8% of the total graduates, +0.3 percentage points (pp) ("https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary%3APercentage_point") when compared with 2020 (32.5%).

The highest shares of women tertiary education graduates in STEM in 2021 were recorded in Romania (42.5%), Poland (41.5%), Greece (40.9%) and Italy (39.0%).

In 2022, there were almost 7.3 million female scientists and engineers in the EU, 310 500 more than in 2021, accounting for 41% of total employment in science and engineering. Women working as scientists and engineers were primarily employed in the service sector, comprising 46% of scientists and engineers, whereas in manufacturing, only 22% of those employed as scientists and engineers were women.

Among the EU countries, the proportion of female scientists and engineers varied widely in 2022, ranging from 53% in Denmark, Lithuania (52%) and Bulgaria (51%) to 31% in Hungary, Finland (32%) and Germany (34%). Scientists and engineers are a subcategory of the broad concept of people employed in science and technology. People are classified as working in science and technology if they work in occupations that could be involved in the systematic generation, advancement, diffusion, and application of scientific and technological knowledge, independently of the level of studies. This category also includes other occupations like technicians or associated professionals.



4.1 DECONSTRUCTING GENDER STEREOTYPES IN CAREER CHOICES AND STEM FROM SECONDARY SCHOOL YEARS

Gender stereotypes lead to a self-efficacy gender gap – the difference between young girls' and boys' confidence and belief in their abilities (European Parliament, 2022/C 67/18). In primary and secondary education, the gender gap in digital competencies is non-existent or in favour of girls. Nevertheless, girls show lower levels of self-efficacy, even when they outperform or perform equally well to boys.

According to the team of the project Girls Go Circular "When it comes to STEM and ICT, there are barriers related to mentality and cultural stereotypes." The experts of the project state that empowering girls and women in science and technology is a policy priority that should be tackled from early childhood to the first years of education. "Deconstructing gender stereotypes through early exposure in education and training supports a more welcoming mindset for young girls wanting to join the STEM and ICT fields and creates an impactful systemic change right from the start" concluded the team.

Gender Gap and Career Choices in STEM Education: Turkey Sample[6]

[3]The document is about the gender gap and career choices in STEM education in Turkey, specifically focusing on middle school students' attitudes toward STEM fields and their interest in STEM careers. This research study explores the attitudes and interests of middle school students, with a focus on gender differences, towards STEM fields and careers. The findings reveal a significant gender gap, with male students exhibiting more positive

3 Ciftci, A., Topcu, M. S., & Erdogan, I. (2020). Gender Gap and Career Choices in STEM Education: Turkey Sample. *International Journal of Progressive Education*, *16*(3), 53-66.

attitudes and higher interest in STEM careers compared to their female counterparts. The study emphasizes the importance of addressing this disparity and suggests strategies such as providing role models, early exposure to STEM experiences, and effective career guidance to encourage greater interest and participation of female students in STEM fields. The main findings of this document are as follows:

- There is a significant difference between male and female students in terms of their attitudes towards STEM fields and their interest in STEM careers.
- Male students tend to have more positive attitudes and higher interest in STEM careers as compared to female students.
- The difference in attitudes towards STEM fields is particularly pronounced in the sub-dimension of "Engineering and Technology".
- The difference in interest in STEM careers is also significant, with male students showing higher interest as compared to female students.
- There is a moderately positive and significant relationship between students' attitudes towards STEM fields and their interest in STEM careers.
- Gender is an important factor shaping interest in STEM fields and attitudes towards STEM careers.
- Approximately 43% of the total variance in interest in STEM careers can be attributed to attitudes toward STEM fields.
- Factors such as parental influence, role models, and early experiences can impact students' interest in STEM.
- The integration of STEM education and project-based learning can positively affect students' perceptions and attitudes towards STEM.
- There is a need for effective career guidance and counseling to support students' interest and choice in STEM fields.

The document does not advise directly good practices in overcoming the gender gap in STEM education. However, it does mention some factors that may contribute to the gap, such as gender stereotypes, lack of female role models, and early experiences. It suggests that efforts should be made to provide equal opportunities and experiences for both male and female students in STEM fields, and highlights the importance of informing and inspiring students about STEM careers. It also mentions the need for teachers to be well-educated about STEM fields and teaching methods. While the document does not provide specific recommendations, it implies that addressing these factors and promoting inclusivity and diversity in STEM education may help to overcome the gender gap.

Gender Stereotypes and Women Participation in STEM Fields in the Western Balkans: A Scoping Review[4]

This document is a research article that focuses on gender stereotypes and women's participation in STEM fields in the Western Balkans including Bulgaria. It presents a scoping review of existing studies on this topic and discusses the impact of gender stereotypes on career aspirations in STEM. According to the document, there is a growing body of literature on the factors that lead to gender disparities in STEM education and professions, highlighting the role played by gender stereotypes and their effect on selecting certain education areas (Chatzi & Murphy, 2022). According to Cheryan et al. (2015), two types of stereotypes influence women's participation in the fields of Computer Science and Engineering. One set of student stereotypes is about the culture (the type of work, the type of people working in certain professions, and the values attached to these fields), and the other set of stereotypes is about girls having fewer abilities in STEM fields, known as negative stereotypes about girls' abilities (Cheryan et al., 2015).

The main findings are as follows:

- Gender stereotypes about STEM subjects are prevalent among high school and college students in the Western Balkans.
- Boys tend to endorse gender stereotypes more than girls.
- Negative stereotypes about girls' and women's abilities in Science and Mathematics contribute to

4 Ferati, M., Demukaj, V., Kurti, E., Mörtberg, C., Shahrabi, K., & Kerolli Mustafa, M. (2023). gender stereotypes and women participation in STEM Fields in the western Balkans: a scoping review. *Academic Journal of Interdisciplinary Studies*, *12*(2), 228-239.

girls experiencing more stress and anxiety in STEM-related subjects.

• Gender-nuanced educational choices are present among youth in the Western Balkans.

• The prevalence of gender stereotypes and gendered educational choices in the Western Balkans has important policy implications for gender inequality and the gender pay gap.

The document suggests some ideas for overcoming gender inequality in STEM. It mentions the importance of using a systems thinking approach to conduct a holistic examination of the issue. This approach involves including relevant actors within and outside the immediate context, such as parents, schools, policymakers, businesses, and organizations. By involving these stakeholders, it is possible to address gender stereotypes and create opportunities for women to participate in STEM fields.

Additionally, the document discusses the potential impact and opportunities that come with digitalization efforts. It suggests leveraging digitalization to increase women's participation in STEM. The disruptions created by the COVID-19 pandemic can be seen as an opportunity for reshaping existing social norms and involving more women in the digital society.

While the document does not provide specific advice on how to overcome gender equality in STEM, it highlights the need for further research and future work ideas to expand the target group and address the underlying factors contributing to gender disparities in STEM education and careers.

Gender Equality Policies and Initiatives for STEM Skills in Greece[5]

According to the document, women face many difficulties during their whole life in following a STEM education and employment. Women should overcome stereotypes about STEM careers during their education, job-seeking, and employment periods.

Previous studies report various barriers that women encounter in STEM higher education such as stereotypes, biases, non-inclusive environments, isolation, absence of mentoring and supportive policies causing stress and exhaustion (Blackburn, 2017). Furthermore, they face extra difficulties in economics, maternity, motherhood, employment, and evolution in job positions. Furthermore, due to financial cuts, there are not many Initiatives to promote women's participation in STEM professions. Thus, the following challenges can be identified:

• Socio-cultural (Gender stereotypes, male dominant jobs, recruitment biases);

• STEM Misconceptions (scientist "nerve", unaware of women fit to STEM job /career);

• Personal Circumstances (female role in the family, pregnancy, maternity, work-life balance);

• Early-stage career (unaware of STEM career opportunities);

• Career development (lack of career management skills, leadership).

• The next section describes Policies and Initiatives aiming to support Greek women to follow a STEM education and career, to enter STEM jobs, and to evolve into high-ranking job positions.

Initiatives and good practices:

Girls Go Circular **("https://eit-girlsgocircular.eu/")**: The program equips schoolgirls aged 14-19 with digital and entrepreneurial skills through an online learning platform about the circular economy. Girls Go Circular has already trained 25.000 girls in 12 European countries and aims to reach 40.000 girls by 2024 across all 27 EU Member States.

Gender4STEM, **("https://www.gender4stem-project.eu/")** an Erasmus+ project in the field of school education coordinated by the Luxembourg Institute of Science and Technology (LIST). During this project, the team managed to create a new, innovative tool to increase gender awareness in teaching STEM in school. You can visit the website dedicated to the project for more information on the tool.

Gender4STEM brought together six partners:

• LIST, **("https://www.list.lu/")** Luxembourg

• VHTO, **("https://www.vhto.nl/")** The Netherlands

• Fundatia Prof, **("http://professionalcentre.ro/")** Romania

5 Perifanou, M., & Economides, A. A. (2020). Gender Equality Policies and Initiatives for STEM Skills in Greece.

• Smart Venise, ("https://smartvenice.org/") Italy

• Consulio, ("https://www.consulio.co/") Croatia

The team had put together the expertise in gender issues, e-learning and teaching, and technology Research & Development to contribute to bringing new solutions to reduce the gender gap in STEM, especially to be used in the context of secondary education. Thus, the Gender4STEM best practices booklet ("https://wide.lu/wp-content/uploads/2020/05/Gender4STEM-best-practices.pdf") has been designed. It includes a collection of best teaching practices, with various resources created by the partners of the Gender4Stem project. The aim is to generate more gender-fair teaching practices and to raise awareness of the existing stereotypes that both girls and women are facing in STEM fields (marie.gallais@list.lu). This project will be continued thanks to Fonds National de la Recherche ("https://www.fnr.lu/") as Gender4STEM in action.

Towards Gender-Sensitive Education ("https://gendersensed.eu/wp-content/uploads/2020/08/A-Handbook-for-Teacher-Trainers.pdf"): Co-funded by Erasmus+, the handbook for teacher trainers describes more than 50 useful activities for enhancing teachers' gender sensitivity.

Arsakeia-Tositseia Schools' STEM Initiatives

Arsakeio (Αρσάκειο) is the general name of the **Arsakeia – Tositseia Schools**, a group of co-ed private schools in Greece, administered by the Philekpedeftiki Etería (Φιλεκπαιδευτική Εταιρεία, **Society for Promoting Education and Learning** [SPEL]), which is a non-profit educational organization. The Arsakeio comprises six schools, with campuses in Psychiko [Attica], Ekali (Tosítseio campus) [Attica], Thessaloniki, Patras, Ioannina, and also Tirana, Albania. The school has more than 6.500 students and 700 educators.

A notable Greek school practice aimed at deconstructing gender stereotypes in career choices and STEM is implemented by the Arsakeia-Tositseia Schools in Athens. These schools have integrated several initiatives and practices to encourage female students to pursue STEM education and careers. Here's a detailed look at their approach:

1. STEM Clubs and Extracurricular Activities

• Robotics Club: The schools offer a robotics club where students, including many girls, can learn about robotics, coding, and engineering. They participate in national and international robotics competitions, gaining hands-on experience and confidence.

• Science Clubs: Various science clubs focus on different branches of science such as biology, chemistry, and physics. These clubs conduct experiments, projects, and research activities that make science engaging and accessible to all students.

2. Incorporating Gender-Inclusive Curriculum

• STEM Curriculum: The schools have integrated a gender-inclusive STEM curriculum that highlights the contributions of female scientists and engineers. Lessons and textbooks are designed to be free of gender bias, showcasing diverse role models.

• Project-Based Learning: Emphasis is placed on project-based learning, where students work on real-world problems and collaborate in mixed-gender groups. This approach ensures that girls actively participate in all aspects of STEM projects.

3. Mentorship and Role Models

• Alumni Mentorship Programs: The schools have established mentorship programs where alumni, especially female graduates who are now professionals in STEM fields, mentor current students. These mentors provide guidance, support, and inspiration.

• Guest Speakers: Regular events featuring female scientists, engineers, and entrepreneurs who share their experiences and career paths. These sessions aim to inspire and motivate female students to pursue similar careers.

4. Competitions and Challenges

• Participation in Competitions: The schools encourage girls to participate in national and international STEM competitions such as the European Union Contest for Young Scientists (EUCYS) and the First

Lego League. Success in these competitions helps to build confidence and interest in STEM fields.

• In-House Challenges: Organizing in-house science fairs and STEM challenges where students can showcase their projects and innovations. These events provide a platform for girls to demonstrate their skills and gain recognition.

5. Professional Development for Teachers

• Gender Sensitivity Training: Teachers undergo training to become aware of gender biases and to learn strategies for encouraging girls in STEM. This training helps teachers to create a more inclusive and supportive learning environment.

• Continuous Learning: Teachers are encouraged to participate in workshops and seminars on the latest STEM education techniques and technologies to ensure they can provide high-quality education to all students.

The organisation provides for competitions and Challenges: Participation in national and international STEM competitions, as well as in-house science fairs, is geared towards secondary school students who have the maturity and skills to engage in such advanced projects. The Arsakeia-Tositseia Schools organises Career Guidance and Counseling: Career workshops and personalized counseling services that help students understand the educational pathways and career opportunities in STEM are focused on secondary school students.

The Arsakeia-Tositseia Schools in Athens demonstrate an effective school practice for deconstructing gender stereotypes in STEM. Through a combination of clubs, inclusive curriculum, mentorship, competitions, and professional development for teachers, they create an environment that encourages and supports girls in pursuing STEM education and careers.

Science Heroes Association Girls Meet Science project

Science Heroes Association (Bilim Kahramanları Derneği (“https://www.bilimkahramanlari.org/”)) is receiving grant support from our Meltem Göçer Fund for the fourth phase of its project “Girls Meet Science”, which they have been supporting since its inception in 2018. The project, in its fourth year, aims to enable girls to gain science, technology, mathematics, and engineering (STEM) skills as well as gain experience in areas such as coding, project development, teamwork, and making presentations.

With the Girls Meet Science project, the organization is bringing together girls living in different cities in Turkey and attending public schools with STEM practices for three years. With the grant support, they have reached 52 teams, 309 children, and 100 teachers from 20 cities.

The organization launched the Girls Meet Science project for the first time in 2018. With the project, they support girls to participate in the FIRST LEGO League Explore Program (“https://www.bilimkahramanlari.org/minik-bilim-kahramanlari-bulusuyor-fll-explore/”), which we run under the name Little Science Heroes Meet. In the project’s first phase, they supported 12 girls’ teams. In the second phase, they prepared an impact report with the Bahçeşehir University BAUSTEM Centre (“https://in-teach.org/”), according to the results of which, students had the opportunity to develop an interest in STEM fields, STEM identity, STEM understandings, and careers.

In addition to ensuring the sustainability of the impact they have created so far, with the 4th phase, the team will realize our goals such as gender equality-themed trainings, preparation and distribution of materials for girls, a digital newspaper to increase visibility and awareness, and an impact report.

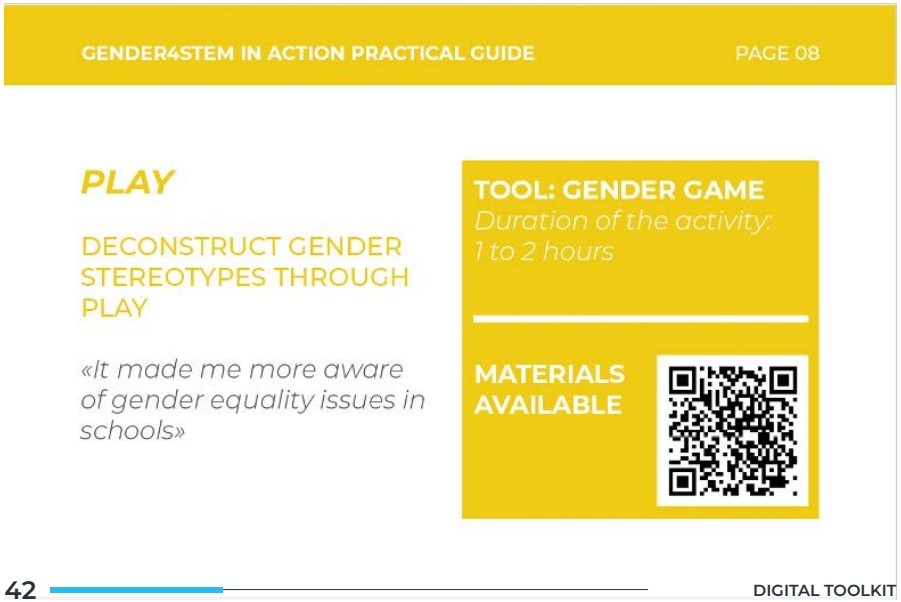
This year’s theme is “CARGO CONNECT”. 20 girls’ teams will research logistics and transportation, and develop project ideas to solve different problems in these areas by exploring how cargo is transported, sorted, and delivered. The teams will create a model from LEGO pieces in the Discovery Set, which will be provided as part of the project, and improve their coding skills by adding moving parts using the “LEGO Education” robot sets. In this process, we plan to encourage the girls to meet with experts from different disciplines to make them understand the importance of thinking more holistically and interdisciplinary way when solving problems.

In an interview ("https://turkeymozaik.org.uk/girls-meet-science-projects-4th-year-promotes-girls-education-in-stem/") the team states:

"This year, we will prepare the Girls Meet Science Set, including inspiring communication materials, with an expert working actively in STEM to increase girls' interest in engineering and basic sciences and their awareness of gender equality. We will conduct workshops to introduce these sets, promote STEM education, and raise awareness about gender equality and discrimination.

In the final stage of the project, the teams will participate in festivals and share their work with their peers, independent observers, and volunteers. Children will receive individual medals, and teams will receive an award in one of their strongest areas (moving model, project or teamwork).

To increase visibility, we will prepare a digital newspaper with the girls and their teachers at the end of the project. We will also prepare a publication where we will get to know the girls participating in STEM and follow their studies (projects, coding, and self-values). By sharing this catalog with CSOs, supporters and volunteers in the field, we aim to create awareness and disseminate the knowledge and experiences that will emerge at the end of the project."



FIRST® LEGO® League is the most accessible, guided, global robotics competition, helping students and teachers to build a better future together. The program is built around theme-based Challenges to engage children ages 9 to 16 in research, problem-solving, coding, and engineering. The foundation of the program is the FIRST® Core Values, which emphasize teamwork, discovery, and innovation.

FIRST LEGO League Challenge is an international science tournament. This tournament is for children and young adults aged between 9 & 16 from 110 countries. Participation allows the participants to feel like they are real-life scientists and engineers.

FIRST LEGO League teams must design, build, and program a robot capable of performing expected tasks using LEGO MINDSTORMS® sets. Guided by an advisor or a volunteer coach who is over 18 years old, each team goes through an educational program before the tournament itself. This program takes at least one and a half hours a week for about three and a half months.

On the tournament day, each team participates in 3 robot matches and attends 3 judging sessions. The robot matches occur on a specially designed table with the challenge field. Each match lasts 2,5 minutes during which the autonomous robot accomplishes as many of the challenges as possible.

Each tournament season has a different challenge theme. The teams define a problem related to the season theme and are expected to come up with an innovative solution. The process includes brainstorming, research, talking to experts, and preparing presentations. A few of the past challenges are food safety, natural hazards, recycling, energy, climate change, water, space, etc.

During this journey, tomorrow's innovators increase their skills in listening, presenting, imaginative thinking, and expressing themselves. They experience friendly competition and learn to share while also experiencing teamwork and gracious professionalism. Participant children and teens take a journey through a fun, process-driven

activity in the fields of science, art, and technology. These experiences encourage them to imagine themselves as scientists, engineers, effective entrepreneurs, and sensible global citizens of the future.

The program is implemented in Turkey since 2004 under the name of Bilim Kahramanları Buluşuyor (Science Heroes Meet).

For further information on the FIRST LEGO League Challenge in Turkey, is provided on the site: www.bilimkahramanlaribulusuyor.org

The international website is https://www.firstlegoleague.org/

According to the E-STEAM ("http://e-steamerasmus-project.com/project%20outputs.html") **Erasmus Project 2018-1-PT01-KA201-047422**

LIST OF STEREOTYPES THAT TEACHERS THINK STILL INFLUENCE/ AFFECT CLASSROOMS
girls spend more time learning but boys achieve better with fewer efforts
girls tend to be more thoughtful when they have to make some decision, boys tend to bemore impulsive
Female- sensitive; Male- powerful
Girls need to be helped/ rescued/to fill task
Boys are curious, playing ball and cars, girls are concerned about physical appearance
boys are better at math, physics, and technology than girls, girls are better than boys inhuman sciences
Girls are quieter, boys are the source of most discipline problems.
Outside the hours, the girls are getting lighter loads than boys
More organized girls, more creative and restless boys
The girls are not interested in steam Boys really like games or challenges.
Stereotypes are mostly occupational, 'cooking pot wives'
Men are presented exclusively as aviators, lumberjacks or carpenters."
Yes, stereotypes that link "STEAM- Computer Engineering - Masculinity"
Usually, science achievements are related to masculinity and men.

4.2 INCREASING VISIBILITY FOR FEMALE ROLE MODELS AND THEIR SUCCESS STORIES

According to Microsoft research across both the US and European research, one finding is key – role models play a significant part when it comes to the level of interest shown in STEM subjects by girls and young women. While parents and teachers are the most obvious role models, especially for young girls, the definition of a role model in this case can be quite flexible. Role models can also include mentors, or leaders/influencers in a STEM field – or even an individual a child has met at a STEM-related club or activity. Regardless of the specific role model in question, the European study shows that role models are the most important factor for driving interest in STEM fields. Some countries such as the Netherlands show particularly low levels of role model exposure, with only 35 percent of respondents stating that they have encouraging STEM role models. Without regular exposure to female STEM role models, many young girls are likely to feel that an interest in STEM is something that moves against the grain of societal norms, likely lending to feelings of friction or uncertainty. If, on the other hand, more female STEM role models are visible, these perceptions can change, giving girls and young women more confidence in chasing their passions.

In addition, the responsibility lies on parents and teachers to show regular encouragement and motivation, in letting girls know that even if there are less women in STEM fields, it's a perfectly acceptable, rewarding path to follow.

Sylvie Laffarge, Director of Philanthropies, Microsoft Europe, states that "The

European research, which has now been echoed by the US study, highlights very similar findings – the need for us to keep focused at changing the male-dominated status quo in STEM fields by exposing more positive female role models to young girls."

A further reason for inspiring women to enter this field of study and career is the professional prospects. There is a need to encourage young girls to engage in future occupations and to take part in the jobs that will build our future society. **("https://www.cbi.eu/market-information/outsourcing-itobpo/software-development-services/market-potential")** In 2014, the European Commission predicted that Europe could face a shortage of up to 900,000 skilled information and communication technology workers by 2020. In 2017, they adjusted this to a deficit of 500,000.

This gender gap may be a brake on the digital transformation that the European Commission wants to achieve. **("https://digital-strategy.ec.europa.eu/en/policies/digital-skills-and-jobs")** It will be hard to build an ICT-friendly Europe if the opportunities for learning and development do not include everyone, especially women. Over the last decade, the EU has seen positive developments to achieve gender balance in the overall pool of doctoral graduates. Despite this progress, in 2018, according to Eurostat, women represent around one-third (32.8%) of the total population of researchers at the European level. At both the European and country level, women researchers account for a lower proportion of the economically active population compared to men researchers.

According to the new edition of the European Commission's "She figures" **("https://ec.europa.eu/assets/rtd/shefigures2021/index.html")**, some parity has been achieved among women with a doctorate. The study shows that in 2018, women represented 48.1% of doctoral graduates. However, they were mainly over-represented in fields such as education and health science and under-represented in technology and engineering. Although the gender gap in PhDs has narrowed, there are still very few women pursuing certain fields of study that are considered predominantly male, and this is due in part to conformity to social expectations, gender stereotypes, gender roles and lack of role models, and it continues to channel girls' career choices away from STEM fields. "*It is true that we have an issue of lack of female representation in STEM. Women only represent 33% of researchers, and only 20% of top-level academics are women. In industry, things are not looking up either*", highlights **Dr Agueda Gras-Velazquez, Science Programme Manager - Head of the Science Education Department (European Schoolnet ("http://www.eun.org/focus-areas/stem")).**

"*We, humans, learn by example, so by providing access to these role models with their personal stories and struggles, we offer girls a great insight on what their future in STEM can be. As we often say, if you can see something, then you can become it*", added **Evita Tasiopoulou, STEM Project and Pedagogical Manager at European Schoolnet**. *"For example, through the STEAM IT project ("http://steamit.eun.org/") and its Repository of STEM Jobs Profiles, it is possible to meet women in the STEM field, learn about the diverse and varied jobs in this field and find inspiration for teaching and integrating STEM education into the classroom*".

Research from Microsoft **("https://news.microsoft.com/features/why-do-girls-lose-interest-in-stem-new-research-has-some-answers-and-what-we-can-do-about-it/")** has revealed that the number of girls interested in STEM across Europe, on average, almost doubles when they have a role model to inspire them.

The new findings from a Europe-wide study of girls and young women shows that in general, there is a clear link between role models and an increased passion for science, technology, engineering and maths subjects, with more interest in careers in these fields, and greater self-confidence.

The results – which are mirrored by Microsoft US research which also shows the importance of role models in inspiring girls to pursue STEM fields – also highlight a concerning gap between the number of girls interested in STEM subjects and the number of young women with actual STEM careers. Microsoft's research stands alongside organisations such as UNESCO

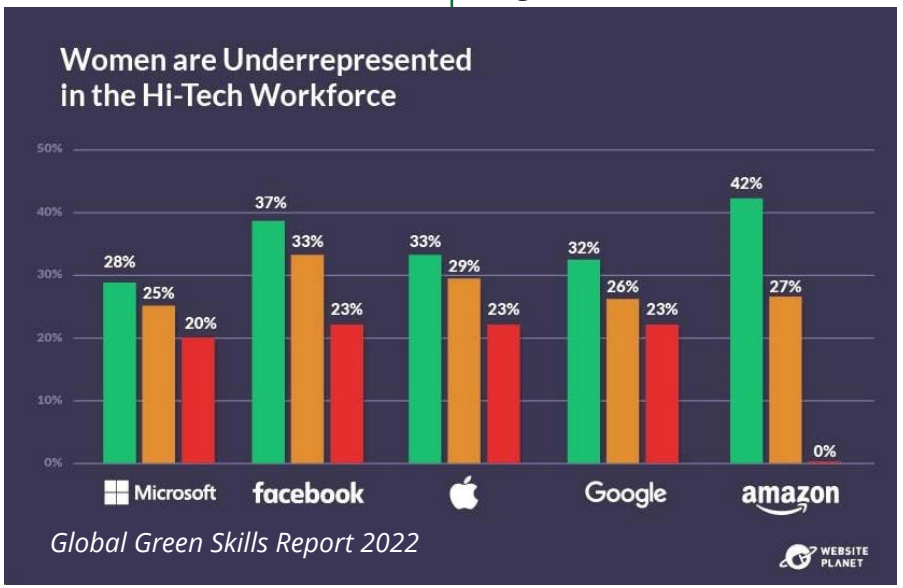
("http://unesdoc.unesco.org/images/0025/002534/253479e.pdf")and Accenture in providing data and insights around the importance of role models in STEM, with the hope that educators, policy makers, NGOs and the private sector can all work together and invest towards bridging the digital skills gap of the future.

Microsoft's research in 2018 saw 11,570 respondents (aged 11 – 30) surveyed across 12 European countries: Belgium, the Czech Republic, Finland, France, Germany, Ireland, Italy, the Netherlands, Poland, Russia, Slovakia and the UK. Teachers and parents were excluded from the definition of 'role models' to ensure that the impact of other types of role models aren't underestimated. Role models for the purpose of the study include fictional (film and literature), real people, and women working in STEM, such as researchers, developers or inventors.

Looking at the results, celebrities are considered to be the least influential role models for driving girls' interest in STEM, while women working in STEM fields are the top drivers, with the most impact. Overall, the research shows that role models clearly have a positive impact on girls' perception of STEM subjects. On average, across Europe, 41 percent of girls with role models report an interest in STEM subjects, compared to 26 percent of girls without a role model. Interestingly, this increased interest in STEM isn't limited to a single subject. On average, across math, physics, biology, chemistry and computer science, having a STEM role model results in a 12 percent increase in interest. Girls with role models are also shown to have more belief in themselves, evaluating themselves as higher performers across STEM subjects. Equally as important, is the fact that the results show that if a girl has a role model for a particular subject area, such as math, a corresponding positive effect is still seen across all other STEM fields. Germany, on the other hand, shows the biggest jump in terms of the interest shown in school subjects when a role model is present (20 percent), while Ireland has some of the highest number of girls – both with and without STEM role models – who can imagine themselves working in a STEM field.

Good practice from BSD education

Founded in 2013 by Chris Geary and Nickey Khemchandani, BSD Education has come a long way from its beginnings in Hong Kong. Starting as a coding academy for students living locally, they soon saw the gaps in education where too often educators struggle with how to bring ever-changing technology to their classrooms and schools confidently and with an in-depth curriculum. 10 years later, they have expanded our global presence across 24 countries and now work with nearly 7,000 schools developing technology skills with an online learning environment, ready-made customizable curriculum, and professional development. They named the company with the ethos of building something different, BSD for short, in education. With this in mind, they now work closely with both students and teachers, with a collective aim to close the educational gaps between education, technology and future careers for the next generations. BSD ideas how to bring female role models into your classroom. Here Are Some Ideas: Make sure they are represented in displays, presentations, and resources; Follow inspiring women on Twitter and share their stories with your class; Hold a "STEM Women in History Day" in March; Invite a Guest Speaker; Create a STEM Mentorship Program;



Good practice from SciGirls - pbskids.org/scigirls

This report was made in collaboration between SciGirls and NASA Science Activation, Space Science Institute, and National Girls Collaborative Project. Most STEM professionals using this guide will be acting as role models, not mentors. Mentors have personal relationships with mentees over extended periods of time of weeks to years, often through internships or other longer programs. According to the report Role Models have shorter connections (up to a few hours) with individuals or groups. Even though role models have short interactions, they still have a lasting impact on helping youth consider career possibilities!

SciGirls suggest a strategy for Role Modeling for STEM in schools.

1. Make a personal connection to create an inclusive learning space.
2. Share your whole self.
3. Share your STEM journey.
4. Show diversity of people in STEM.
5. Encouragelearningfromsetbacks.
6. Communicate how your work impacts people, your community, and the world.
7. Show how STEM is creative and collaborative. 8. Provide resources for support and guidance.

The complete guide is at the pbslearningmedia.org/collection/scigirls.

Many STEM activities for girls could be found at the following links.

- **SciGirls on PBS LearningMedia:** pbslearningmedia.org/collection/scigirls/
- **STAR Net STEM Activity Clearinghouse:** clearinghouse.starnetlibraries.org/
- **JPL Teach:** jpl.nasa.gov/edu/teach/
- **NISE Net Activities:** nisenet.org/browse-topic
- **NASA Science Activation:** science.nasa.gov/learn

Good practice Gender4STEM program - Erasmus Plus funded project

Gender4STEM **("https://wide.lu/wp-content/uploads/2022/02/guide_g4s_EN.pdf")** came into being thanks to secondary schools and teachers in Luxembourg who raised the burning question: How can we attract more girls to our classes in technical and computer science subjects? The project was therefore developed with the aim of transferring knowledge and expertise on gender issues in technology and providing resources to education staff. **WIDE** (Women in Digital Empowerment) and **LIST** (Luxembourg Institute of Science and Technology). At the request of numerous schools and teachers, we started our work with the Erasmus+ project «Gender aware education and teaching» (Gender4STEM). Co-funded and led by the LIST (Luxembourg Institute of Science and Technology), (this project brought together six European partners - experts in gender, technology and learning - to increase girls' interest in STEM subjects. One of the goals of the project was to help teachers strengthen their teaching practices on the topic of gender.

Description

This workshop aims to highlight and discuss the stereotypes that students think of when women in STEM disciplines are mentioned. Afterwards, they should research female role models, create biography cards and create a timeline.

By learning about historical and contemporary female role models in STEM, this activity will inspire girls (and boys) to take an interest in these disciplines and stimulate their skills in researching and synthesizing information as well as in working together.

How to do this exercise? Session 1 (1hour):

- Identify and discuss the stereotypes that come to students' minds when they think about girls and women in STEM.
- Ask students to write them down on post-its, stick them up on the board and talk about them.
- Q&A session on the subject.

Session 2 (1hour):

- Creation of «TOP TRUMPS» cards on historical or contemporary women scientists.
- Ask students to choose a female STEM role model and find out about her discoveries, her role in science,...*
- Next, ask them to create a «TOP

TRUMPS» card for the chosen scientist, adding their own topics and giving their own notes.

Session 3 (30 minutes):

- Create a timeline with all the cards and display it in the school corridor.
- Feedback from the students.

Feedback:

This was done in biology class with 20 pupils aged 12 (50% girls and 50% boys) at the International School of Luxembourg (ISL).

The questions asked before and after the experiment showed a better understanding of the role of women in science, and the pupils themselves felt these roles were more accessible to them.

Teacher's comments: «As a biology teacher, I now take more time to reflect on and highlight the role that women have played in getting to where we are now in terms of scientific progress.»

Students' comments: «People have stereotypes», «Scientists are smart», «Why do people think women can't do the same things as men?»

Practical advice:

This activity can be organised as part of an equality-focused curriculum.

*Sources: https://500women-scientists.org/press.

Good practice from T4Education

T4 Education is a global platform bringing together a community of over 200,000 teachers from more than 100 countries to transform education. From our T4 Communities app to our Best School to Work programme, prizes, Insights, and events, we provide teachers and school leaders with professional development and opportunities to learn, share, and network with peers from around the globe. They believe in the power of teachers and schools with a strong culture to not only equip the next generation to fulfil their full potential, but to empower them to tackle the greatest challenges our societies face. T4 Education was created during the greatest crisis global education has ever faced. With school and university closures affecting over 1.5 billion students, the path to meeting SDG 4 became that much harder and the need for change became urgent. Its founder, Vikas Pota, imagined a world where every child has access to quality education. This vision couldn't be achieved solely through top-down reforms – it required change starting from the grassroots level. In February, 2024, the UN marked its International Day of Women and Girls in Science, noting: "Although Science, Technology, Engineering and Mathematics (STEM) fields are widely regarded as critical to national economies, so far most countries, no matter their level of development, have not achieved gender equality in STEM." N4Education promotes role models for girls considering pursuing STEM education.

Radia Perlman

One such trailblazer is Radia Perlman, often hailed as the "Mother of the Internet". Her invention of the Spanning Tree Protocol (STP) has been instrumental in ensuring the stability and efficiency of networked systems. Perlman's story serves as a testament to the transformative impact women have had in traditionally male-dominated fields

Gladys West

Gladys West played a pivotal role in the development of the Global Positioning System (GPS). Her mathematical expertise and

dedication contributed significantly to the accuracy of satellite geodesy, ultimately shaping the way we navigate and understand our world.

Katherine Johnson

Katherine Johnson, a mathematician at NASA, is another inspirational figure who defied racial and gender barriers. Johnson's calculations were crucial to the success of early space missions, including John Glenn's historic orbit around the Earth.

Hedy Lamarr

Hedy Lamarr, renowned as a Hollywood actress, was also a brilliant inventor. During World War II, Lamarr co-invented a frequency-hopping technology that laid the groundwork for modern wireless communication.

The importance of female role models in STEM education

Female pioneers in STEM rarely receive the same recognition as their male counterparts, despite their pivotal roles in history. It's crucial that we celebrate their achievements and understand their importance so that today's female students considering the path ahead can have role models to look up to and see that STEM is not the preserve of men alone.

While celebrating these extraordinary women, it is also important to recognise that the impact of female role models extends beyond the pages of history. Girls need relatable figures who can inspire them in the present, guiding them through their educational journeys.

Mentorship programmes that connect female students with female professionals in STEM can provide valuable guidance and insights. These programmes can help bridge the gap between the classroom and the real world, offering a glimpse into the diverse and exciting careers available in STEM fields.

Teachers change lives

But even before thinking about STEM in the workplace, today's girls must first decide that they want to study STEM. And that's where our teacher community comes in. Teachers are among the most important role models girls can have when it comes to encouraging them to pursue STEM.

Teachers, particularly female educators in STEM, play a vital role in shaping the attitudes and aspirations of their students. These educators serve as living proof that girls can excel in STEM fields. Through their expertise and leadership,

female teachers become powerful agents of change, breaking down stereotypes and fostering a welcoming environment for all students.

School culture is key

Building a great school culture is key to empowering both female teachers and students in the sciences. This involves creating an inclusive atmosphere where everyone feels valued and supported, regardless of gender. This is all part of the Hidden Curriculum, those unspoken values underpinning a school's environment – both in terms of students' learning and teachers' teaching.

This is not an easy thing for schools to get right, and it can be difficult for schools to take a step back and objectively analyse where they are on the right track and where they could improve when it comes to inclusion and equity and supporting female teachers and students. This is why we're supporting schools through our Best School to Work ("https://t4.education/best-school-to-work/") programme, which helps them transform their culture and working environment, as well as our World Schools Summit ("https://t4.education/world-schools-summit-2/"), which will bring together some of the world's best schools and global education leaders to empower schools through unlocking the Hidden Curriculum.

If schools can harness the Hidden Curriculum with the right values, and build the right working environment that encourages and empowers female STEM teachers, then they can help ignite girls' passions for STEM from an early age by providing them with role models in the classroom. That will be one step on the road to gender equality in science and tech. There will be many more steps to take.

4.3 CREATING AN INCLUSIVE STEM ENVIRONMENT FOR GIRLS IN SECONDARY SCHOOLS

Good practice from Bulgaria ("https://www.stemcoalition.eu/programmes/building-school-stem-environment-stem-programme-government-bulgaria")

The national program 'Building a School STEM Environment' is a large-scale STEM programme of the government of Bulgaria. Its primary focus is to create new school 'centers' - an integrated set of specially created and equipped learning spaces with a focus on the study and application of competencies in the field of natural sciences and mathematics in state and municipal schools in the country. The centres will support a range of education innovations, including new teaching methods, teaching environments and educational content.

Description and objectives:

The national program 'Building a School STEM Environment' aims to create new school centers - an integrated set of specially created and equipped learning spaces with a focus on the study and application of competencies in the field of natural sciences and mathematics in state and municipal schools in the country. Each school center will include the following elements:

- physical environment (improvement of the interior architecture and furnishing of existing spaces)
- technology (equipment)
- learning content,
- teaching methods
- management of the educational process.

The main objective of the programme is to create an integrated learning environment for a new generation in Bulgarian schools, which will encourage and support educational innovations in teaching and learning in the field of STEM, creativity and research. The investments will support the introduction of new teaching methods, raising the qualification of pedagogical specialists and creating new educational content in the direction of integrating the subject areas of STEM. The Program is in line with Bulgaria's Digital transformation Policy and National Science Strategy 2017-2030.

According to the "School STEM Environment" procedure, new STEM classrooms are planned to be built in all over 2,200 schools and centers for special educational support in the country. Under the National Program 'Building a School STEM Environment', over 250 STEM centers have been established in Bulgarian schools. The goal is to have a STEM center in every state and municipal school by 2026, with a significant financial commitment of 270 M euro – backing this initiative. The emphasis is not just on infrastructure but also on training close to 40K teachers by 2027 in the competency-based model tailored for STEM environments.

Currently, an impressive 2247 schools (out of a total of 2271) have submitted their concepts for the approval of equipment and the physical environment to the National STEM Center. Once approved, these schools will move forward with their project proposals, marking a significant stride toward achieving the goal set for 2026.

The financial commitment to this endeavor is substantial. The total value of the project stands at close to 270 million euros, with schools of varying sizes eligible for different financial resources. For instance, schools with up to 50 students can receive up to €25K , while larger institutions with over 1000 students can avail up to €300K.

However, infrastructure alone does not guarantee the success of STEM education. The teaching methodology and the competency of educators play a pivotal role. Recognizing this, the National Program 'Modernization and Quality of Education' aims to train 39K teachers by 2027 in the competency-based model tailored for STEM environments. The National STEM Center further bolsters this initiative by offering teachers access to equipment in their demo laboratory and providing free training resources, published in the e-library on the National STEM Center's website.

Good practice - Hands-On Physics Learning in a STEM Environment in "Ivan Vazov" language high school, Plovdiv ("http://egiv-plovdiv.bg/bg/?s=%D0%A1%D0%A2%D0%95%D0%9C%2B%D0%9F%D0%A0%D0%90%D0%9A%D0%A2%D0%98%D0%9A%D0%98")

The school has established a STEM center ВИТХ appliances, consumables laboratory and innovative learning environment, presentation room and room for experiments. The school applies an inquiry learning model. The teachers use virtual laboratories and interactive simulations. The students work in small groups on a problem. The teachers give them practical activities on the selected subject. The groups choose between google doc, infographic or video. The students do research, experiment creation and presentation. The method includes - hypothesis, watching and explanation approach. Themes as examples are as follows: Determining Planck's constant - the students should be acquainted with the formula of Maks Planck for the energy of one photon. The lesson combines learning objectives in Physics, Maths and IT. The teachers use LED's to establish electric circuits. They observe LEDs, its voltage changes, they gain experience in connecting electric circuits with studied elements and devices in grade 9. Another lesson is dispersion and its application in Herschel's experiment. Another lesson is observation and study of spectra. The school students from 10th grade had participated in the World Wide Data Day on 23rd of November, 2023. They had to use the app Hypatia with integrated data from collisions of accelerated neutrons to see if new mass parts are born.

The conclusion is that the new STEM center raised the students' motivation for learning. The teachers said that the STEM content should be taught to students with special interests in the subjects but also to all students. When it is presented to all students there should be one month as minimum for preparation and teaching on the topic.

Useful links:

www.golabz.eu htpps://laser-classroom.com/all-free-lessons

https://perimetererinstitue.ca/classrom-simulations.

Good practice from USA - Harpeth Hall STEM center for girls **("https://stem.harpethhall.org/leading-the-way/center-for-stem-studies")**

In Harpeth Hall, girls learn to have confidence in their opinions and respect the power of their voices. They also learn to listen for learning and understanding. Here, all students are seen, heard, and valued.

They don't strive for perfection, instead we value progress. They encourage students to take healthy risks — even if they make mistakes — because we all learn best that way. We know that building confidence and resilience go hand in hand with learning to lead ourselves and others.

In the middle school, their girls stand on a firm foundation of skills in STEM **("https://www.harpethhall.org/fs/pages/4906")**, humanities, and visual **("https://www.harpethhall.org/fs/pages/4385")** and performing arts as they are encouraged to go beyond the curriculum with our SEEK independent study program **("https://www.harpethhall.org/fs/pages/4628")**.

"It is dissection day in the marine science Winterim class at Harpeth Hall. After a week of learning about crayfish and starfish, Upper School students approach their lab tables. The energy is kinetic. In front of them: dogfish sharks. Poised for discovery, the girls slowly slide their scalpels across the sea creatures' skin. They explore the contents of the stomachs and organs with their blue-gloved hands. As the students work, they begin exclaiming about their discoveries.

One pair finds the back half of a bony fish, including the caudal fin, in their shark's stomach. Another group finds a crab's big front claw — the "cheliped claw" as they learned. And then, as the girls move to the reproductive system dissection, two students make the most exciting find of all — shark pups. That thrill of hands-on discovery and the chance to engage interactively with the concepts learned in class captures students' attention and inspires them to seek more opportunities in STEM.

Despite comprising nearly half of the U.S. workforce, women are still vastly underrepresented in science, technology, engineering, and math, making up less than one-third of STEM professionals. Our students still have glass ceilings to shatter."

Good practice from Creation and Integration of STEAM Model in General Education project /School/Coordinator: Vilniaus Gedimino

technikos universiteto inzinerijos licejus, Lithuana, 2022

Methodologies

• Using multidisciplinary approaches- coupling the subjects (e.g. English+Geography, PE+Music, Math+Lithuanian etc.) to foster creative problem solving and proactive attitudes

• Facilitating peer collaboration and students' engagement, improving personalized learning through the use of a wide range of IT technologies e.g. Classflow, Nearpod, Mentimeter, Quizizz, Answer Garden etc.

• Taking advantage of thinking maps and other graphic organizers

• Pioritizing group working Environments

Environments

• School activities in STEAM learning surroundings such as Bio Lab, IT classroom, Engineering Lab, Science Lab, etc.

• Visiting Vilnius tech university, its laboratories, libraries, and other facilities and workshops at Panevėžys STEAM center

• Numerous activities carried out abroad:

• Portugal– visiting a plastic factory with a focus on recycling of collected used plastic

• Turkey– visiting recycling factory, learning how biomass from household waste can be used for heating homes

• visiting The Green House in Turkey to explore innovative solutions facilitating plant irrigation, and the production of electricity from solar panels.

Teachers

The teachers' active participation involved:

• creating and implementing lessons based on STEAM methodology,

• visits to partners' educational institutions (Turkey, Portugal, Lithuania),

• cooperation and peer learning.

• sharing best practices

• By being actively involved in the STEAM model project our teachers had a possibility of updating and augmenting their skills and competencies.

Impact

• The students benefited considerably by actively participating in the STEAM-based lessons.

• The students were encouraged to reconsider their attitudes, dispositions and behaviours. They increased their motivation, self-assessment, self-efficacy and autonomy, as well as communication, collaboration, engagement, and learning productivity.

• Easy access to the created project website STEAM model enables

• The whole community has access to and makes use of the outcomes of the project and other useful resources via the STEAM model project website.

Good practice from STEM at Anatolia College/Thessaloniki

("https://anatolia.edu.gr/en/stem/anatolia-college-stem-center")

The STEM Center coordinates 21st Century Science, Technology, Engineering and Mathematics skills-related activities in both primary and secondary education at Anatolia College.

Anatolia College has adopted the STEM approach both in-classroom, with exploratory learning-based modules, and out-of-classroom with clubs, after-school and weekend programs. We offer our students both the knowledge and the opportunity to apply it by cultivating skills that will enable them to succeed and adapt to an ever-changing environment.

ACSTAC

With the aim of promoting Science, Technology, Engineering and Mathematics (STE (A) M), ACSTAC is a pioneering educational initiative that invites students of all grades of High School and Lyceum of General Education in Greece and abroad to develop research skills, critical thinking, collaboration and communication, presenting their work as real researchers in a student scientific conference. Green education and the importance of linking the concept of sustainability and social responsibility with STE (A) M are now central. ACSTAC is under the auspices of the Ministry of Education, Research and Religions, CERN, EPS (European Physical Society), the Aristotle University (AUTh) and the Union of Greek Physicists. The first four student conferences were attended by a total of 2,700 students from Greece and abroad, while in 2014 alone more than 1,000 students from Greece, Romania, Turkey, Moldova and India participated. The extensive program of

the conference is complemented by workshops and lectures given by internationally renowned scientists.

Good practice from Instructables ("https://www.instructables.com/about/")

Instructables started out in 2005 as a documentation system for open source experimental kitesurfing by members of Squid Labs. When they weren't solving interesting problems like solar panels for driveways, efficiently harnessing human power, or strain sensing ropes, you could find them sharing Instructables from their workshop. From 3D printing to cooking, to making anything fly, Instructables became the recipient of countless hours of tinkering, soldering, stitching, frying, and fun.

Since its founding, Instructables has grown into an amazing community of curious doers from around the world and is home to hundreds of thousands of projects. In 2011 Instructables became a part of Autodesk, which believes in empowering innovators everywhere to take the problems of today and turn them into something amazing. By sharing what we make, we are able to connect across boundaries and prepare ourselves with the skills needed to adapt to the future's challenges. Every day we continue to be amazed by the imagination, curiosity, and simple awesomeness of everyone who shares their creations with us on Instructables.

The Oakland Toy Lab ("https://www.instructables.com/100-STEAM-Projects-for-Educators/")- it is a collection of 100 STEAM Projects created for teachers and educators to do with youth. Each project encourages exploration, modification, and students to pursue their own ideas and curiosities. They are also meant to be accessible, both in approach and availability and cost of materials. Feel encouraged to adapt them to your local learning space.

3.4 INCLUSIVE STEM APPROACHES SUCH AS PROBLEM-BASED LEARNING (PBL), CHALLENGE-BASED LEARNING (CBL) AND PERSONALIZATION OF LEARNING COULD GENERATE SOLUTIONS TO LOWER GENDER DISPARITIES IN STEM.

Inclusive STEM approaches such as problem-based learning (PBL), challenge-based learning (CBL), and personalized learning could generate solutions to lower gender disparities in STEM. PBL and CBL engage students with real-world problems and challenges, fostering collaboration and critical thinking. These methods encourage diverse perspectives and create a more inclusive environment. Personalized learning tailors education to individual strengths and interests, providing support and encouragement for underrepresented groups. By making STEM education more engaging and accessible, these approaches can inspire more girls and women to pursue STEM fields, ultimately reducing gender disparities.

The European Schoolnet's "STEM Alliance" http://www.stemalliance.eu/ emphasizes that CBL boosts students' interest in STEM careers, particularly among girls, by connecting classroom activities to real-life challenges.

Moreover, the EU-funded project "Hypatia" recommends personalized learning to address gender disparities.

Their toolkit provides evidence that tailoring STEM education to individual interests and strengths increases female students' participation and retention.

3.5 INNOVATIVE SCHOOL AND OUT-OF-SCHOOL PRACTICES IN CLIMATE CHANGE AND GREEN EDUCATION THROUGH STEM IN SECONDARY SCHOOLS

The European competence framework on sustainability ('GreenComp') ("https://publications.jrc.ec.europa.eu/repository/handle/JRC128040") was published in January 2022. This framework, which has been translated into all official EU languages, can be used in education and training programmes and policies in formal, non-formal and informal settings.

The framework defines the four competence groups related to sustainability that should be acquired by learners of all ages. Each competence has three sub-parts.

Embodying sustainability values

- valuing sustainability
- supporting fairness
- promoting nature

Embracing complexity in sustainability

- systems thinking
- critical thinking
- problem framing

Acting for sustainability

- political agency
- collective action
- individual initiative

Envisioning sustainable futures

- futures literacy
- adaptability
- exploratory thinking

In 2023 the Commission is establishing a Community of Practice to connect schools, researchers, public authorities and other bodies using the new competence framework.

Three of the Academies, started in 2022 and running for three years, are focusing specifically on sustainability.

EduSTA (“https://projects.tuni.fi/edusta/”) will create learning pathways where teachers can develop and demonstrate their sustainability education competences with digital badges.

“The book “Teacher Training for Education for Sustainable Development: Developing a Shared Competence Framework” is tangible evidence of the collaborative efforts of committed researchers, educators and policy makers who are striving to improve the quality of teacher education for sustainable development. This work crystallizes valuable insights gained from in-depth research, workshops and interviews conducted in five collaborating countries, and lays the foundation for a unified competency framework that crosses borders and strengthens the global dialogue on education.”

Download eBook: Teacher Training for Education for Sustainable Development: Developing a Shared Competence Framework

(“https://projects.tuni.fi/uploads/1955/20/880b1ad0-edusta_978-80-213-3324-6.pdf”)

The TAP-TS (“https://tap-ts.eu/”) project will produce, test and validate packages of resources relating to sustainability for schools and teacher education.

Outcomes

- Online Webinars (“https://tap-ts.eu/course/index.php?categoryid=5”)
- Active Learning Events (“https://tap-ts.eu/course/index.php?categoryid=6”)
- Spring Schools (“https://tap-ts.eu/course/index.php?categoryid=7”)
- Summer Schools (“https://tap-ts.eu/course/index.php?categoryid=8”)

Resources

- Learning & Teaching Packages (“https://tap-ts.eu/course/index.php?categoryid=9”)

CLIMADEMY (“https://en.uoc.gr/announce/climademy.html”) is focusing on helping teachers to better understand climate change drivers, impacts and mitigation options and will create a network of teachers on climate change education.

BEST PRACTICES IN ENGAGING GIRLS IN STEM 4 GREEN SKILLS IN SECONDARY SCHOOLS

5.1 ACTNOW (2020-3-CY02-KA205-001979) CO-fiNANCED BY ERASMUS PLUS PROGRAM

General description - STEM 4 Green Skills

Innovative educational tools for better integration of climate change topics and sustainable development in formal and non-formal educational systems; Make use of the existing AR and simulation games platforms and provide youth workers and educators with the necessary technical knowledge to create their content for fostering young people key competences through learning about climate change.

Key words - Simulation-based training, role-playing education, scenario-based learning;

Who - CENTRE FOR ADVANCEMENT OF RESEARCH AND DEVELOPMENT IN EDUCATIONAL TECHNOLOGY LTD-CARDET LYKAVITOU AVENUE 29 1ST FLOOR ENGOMI 2401 LEFKOSIA, Cyprus

Website: https://www.cardet.org, Phone: +35722002100

When - Start date 01-02-2021/ End date 31-03-2023/finished

Where - Europe

Good practice - The ActNow e-learning platform offers the user a plethora of online and offline activities, case studies, and role-play scenarios as well as vast bibliographical research on the theme of climate change issues, and tools to raise awareness for it. The platform is separated into two thematic areas, according to the user's background, expertise, and needs. The "Are you a an individual" section aims to the user who wants to go through the aforementioned activities at a self-paced mode, and exercise the gained knowledge through the interactive case studies. The "Are you a trainer" is tailored to the environmental awareness trainer, facilitator or educator and it gives all of those mentioned above as well as extra tools for the most productive and engaging training ("https://actnow.cardetprojects.com/")

Recommendation

Simulation Zero emission model application in secondary schools - ("https://actnow.cardetprojects.com/mod/scorm/player.php")

The second simulation is a discussion about the way a small island community can follow the "intelligent islands" and green ICT models. A medium-sized Greek island municipality has decided to adopt zero-emissions practices. The learners will work in groups, representing individuals from the island and their interests.

Learning outcomes:

1. find new zero-emissions solutions for a small community
2. identify opportunities for a small community's economic growth, using green technologies
3. argue for or against new technological solutions for a local community's life

The third simulation is a public debate about regular and green mobility.

Scenario 3 - Regular or green mobility?

The learners will work in groups representing citizens, entrepreneurs, car retailers and officers. They will debate about a settlement's transport facilities.

Learning outcomes

At the end of the simulation, the learners should be able to:

1. assess the environmental impact of conventional and green transport modes
2. argue for or against the different transport modes

5.2 GIRLS AS LEADERS IN STEM (GALS) - FUNDED BY A PHILANTHROPIC ORGANIZATION (THE INVERGOWRIE FOUNDATION)

General description - The program aims to develop the girls' STEM capabilities by targeting factors that influence societal, generational, and systemic change by:

- Exposing girls to the existence of alternative education pathways and a wide range of rewarding STEM occupations;
- Changing the culture of participating schools (leaders, teachers, and students) and of the broader community to acknowledge STEM pathways as potential alternatives for girls, and enable girls as leaders and entrepreneurs in STEM;
- Involving various stakeholders in education and industry;
- Strengthening STEM teaching and learning, using 'real-world' STEM scenarios, and involving industry partnerships in knowledge transfer into education.

Key Words - girls in STEM ("https://www.mdpi.com/search?q=girls%2Bin%2BSTEM"); industry school - partnerships ("https://www.mdpi.com/search?q=industry%2Bpartnerships"); engagement ("https://www.mdpi.com/search?q=engagement"); career aspirations ("https://www.mdpi.com/search?q=career%2Baspirations")

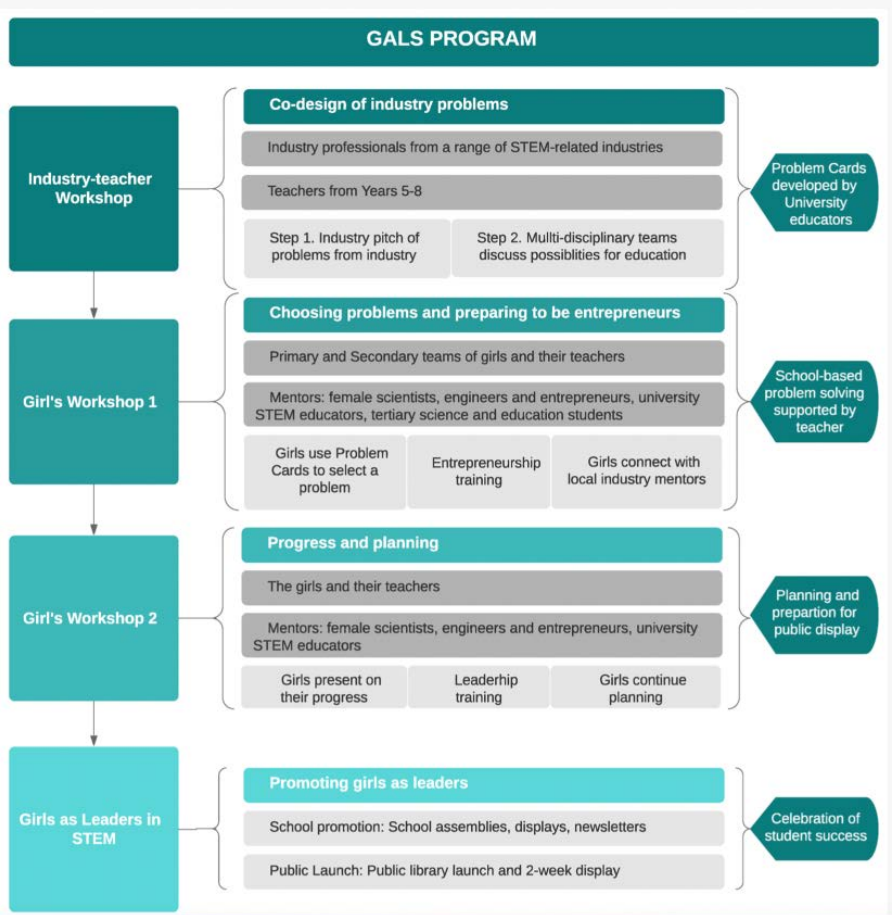
Who - School of Education, Faculty or Arts and Education, Waurn Ponds Campus, Deakin University, Geelong 3220, Australia

When - 2021 - 2023

Where - Australia

Good practice - The program aimed to develop the girls' STEM capabilities by targeting factors that influenced societal, generational, and systemic change by:

- Exposing girls to the existence of alternative education pathways and a wide range of rewarding STEM occupations;
- Changing the culture of participating schools (leaders, teachers, and students) and of the broader community to acknowledge STEM pathways as potential alternatives for girls, and enable girls as leaders and entrepreneurs in STEM;



- Involving various stakeholders in education and industry;
- Strengthening STEM teaching and learning, using 'real-world' STEM scenarios, and involving industry partnerships in knowledge transfer into education.

Program description

Website - https://www.mdpi.com/2071-1050/14/9/4897

Stage 1. The Industry-teacher Workshop—A Pitching Event

In Stage 1, teachers and industry partners are brought together in an indus-

try-teacher workshop facilitated by university educators to discuss the potential industry problems that can be translated into curriculum for the girls. A range of local industries is canvassed for their participation in the industry-teacher workshop. To date, the project has engaged representatives from thirteen industries as diverse as the fashion industry through to a hydrogen technology hub. As an outcome of the teacher/industry workshop, 'Problem Cards' were developed for each industry. The problem cards use the concept of newspaper stories that provide a context to the industry's challenges, presenting science as a real-world translation of technical STEM work. Each card is a two-sided A4 sheet that maintains the same structure and targets components to provide continuity for the girls, with three interspersed textboxes to scaffold student exploration of the stories. The 'Scoping Statement' gives the girls a broad sense of the industry problem. Four to six 'Stimulus Stories' provide details about various aspects of the industry in focus. A set of 'Stimulus Questions' prompt thinking around the solution to the industry problem. The problem cards are sent to the industry professionals to ensure that the key ideas are represented.

Stage 2. The Girls' Involvement in Design-based Learning

The schoolgirls from years 5–8 were engaged for four months in a series of two workshops and mentoring activities that facilitated a collaborative design-based learning experience where they explore the creative possibilities of STEM. During the two workshops, the girls were mentored by female scientists, engineers and entrepreneurs, Deakin University STEM educators, and tertiary students to foster the girls' interests in STEM and entrepreneurship, develop STEM skills and knowledge, and build their professional networks. In between workshops, the girls were mentored and guided by teachers at their schools and the school liaison officer.

During the first workshop, the girls were introduced to the industry problems through the problem cards, and to the engineering design-challenge process. The outcome of the workshop was to prepare them to proceed with designing their solution, and where desired, make links with their industry partner to follow up in coming weeks (for example, through ongoing contact/support/mentoring or for an excursion to the local business). In the second workshop, the girls presented their progress to each other and participated in leadership training. The teams were supported to plan for a public launch that showcased their solutions to their industry-related problem. The outcome of this workshop was to develop plans for finalizing their solutions and developing posters or prototypes of their solutions.

A number of showcase events were held towards the end of the program that helped to establish the girls as leaders at their school and in the community. In the school-based event, the girls established themselves as school leaders by reporting their project outcomes to their schools at a school assembly, and through displays and/or school newsletter acknowledgements. To raise awareness of the possibilities of girls' involvement in STEM careers, a public launch of the girls' projects was held in a local public library, where certificates of participation were presented to the girls by the local federal member of parliament and other dignitaries. In addition, the girls' projects were placed on display across a two-week school holiday period and were available for public scrutiny and to raise further community awareness of Girls as Leaders in STEM.

The girls' project topics varied, not just in how the topics related to the problem cards, but also from school to school. Interestingly, the majority of the topics and projects had a sustainability element or focus. The following table (Table 2) provides an overview of the ten projects and indicates the link to the associated problem card.

Recommendation

Good ideas for school project topics

1. Interchangeable car pods—designing new interiors for family cars. Links with problem card—automotive industry;
2. Designing new measurement devices—repurposing plastic. Links with problem card—managing waste and new materials;

3. Community education campaign—designing a campaign to educate on recyclable materials. Links with problem card—managing waste;

4. Minimising packaging—considering new material suitable as packing for the clothing industry. Links with problem card—managing waste and fashion industry;

5. Designing an inclusive playground. Links with problem card—inclusive society;

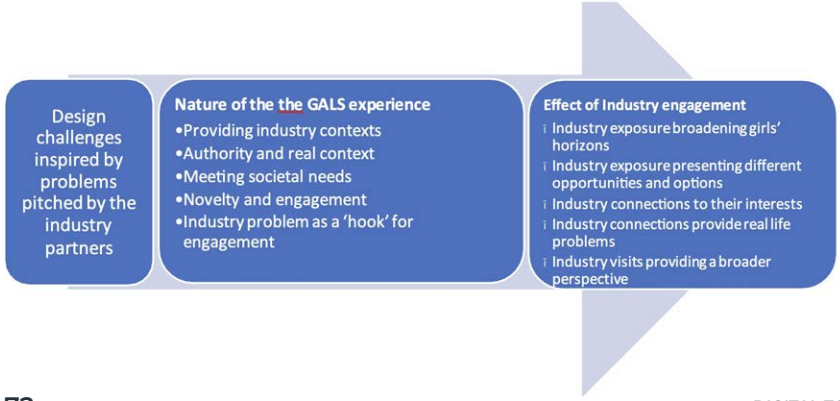
6. Packaging of clothing in fashion industries. Links with problem card—managing waste and fashion industry;

7. Inclusive playground—designing play items for an outside playground that encourages inclusive play. Links with problem card—inclusive society;

8. Designing and creating effective writing grips;

Teachers participating in the program have asked their students to:

- Work in teams to solve problems Plan and carry out investigations
- Obtain, evaluate, and communicate information Relate to contexts drawn from STEM industries Model with mathematics
- Ask questions and define problems Represent data in a variety of modes
- Use design software to output to a 3D printer Undertake learning activities drawn from innovations and advancements in science and technology
- Use video and image capture and manipulation Use mathematics and computational thinking Construct explanations and design solutions Use appropriate mathematics tools strategically Generate questions to investigate
- Solve problems they have generated



The figures shows a graphic depiction of the effect of industry engagement on girls' STEM awareness, attitude, and engagement.[96] *FOR PEER Sustainability 2022, 14, x*

5.3 STE(A)M IT - AN INTERDISCIPLINARY STEM APPROACH CONNECTED TO ALL AROUND US, WILL PRODUCE THE FIRST EUROPEAN INTEGRATED STE(A)M FRAMEWORK - FUNDED BY ERASMUS+ PROGRAMME OF THE EUROPEAN UNION

("https://ec.europa.eu/programmes/erasmus-plus/node_en")

6 Campbell, C., Hobbs, L., Xu, L., McKinnon, J., & Speldewinde, C. (2022). Girls in STEM: addressing SDG 4 in context. *Sustainability*, *14*(9), 4897.

General description - The STE(A)M IT project aims to (1) create and test of a conceptual framework of reference for integrated STE(A)M education;

(2) develop a capacity building programme for primary schools teachers and secondary STEM teachers, based on this framework, with a particular focus on the contextualization of STEM teaching, especially through industry-education cooperation, and (3) further ensure the contextualization of the integrated STEM teaching by establishing a network of guidance counsellors/career advisors in schools promoting the attractiveness of STEM jobs to their classes.

Website:

http://steamit.eun.org/

This first European integrated STEM framework of reference will comprise of:

- A Master Learning Scenario guiding teachers on how to teach in an integrated way.
- 7 Example Learning Scenarios for Secondary education (12 – 16 years old) and 4 for Primary ed-

ucation (6 to 11 years old) with real case scenarios, based on the Master Learning Scenario.

- A Capacity Building Programme for Secondary and Primary School teachers on teaching in an integrated way.
- A network of teachers to exchange on integrated STE(A)M teaching.
- A report on the development and use of this teaching methodology in real case scenarios, including tips and guidelines for integration at Ministries of Education level as well as by schools.

Find out more about the project:

- About the work packages (http://steamit.eun.org/work-packages/)
- About the team ("http://steamit.eun.org/the-team/")
- About the framework ("http://steamit.eun.org/about-the-project/the-framework/")

Key Words - STEM, Art, integrated STE(A)M education, capacity building programme for primary schools teachers and secondary STEM teachers, industry-education cooperation, network of guidance counsellors/career advisors in schools promoting the attractiveness of STEM jobs to their classes.

Who - STE(A)M IT ("http://steamit.eun.org/about-the-project/our-objectives/") is an Erasmus+ funded project coordinated by European Schoolnet (Belgium) in partnership with Istituto Nazionale di Documentazione, Innovazione e Ricerca Educativa (INDIRE) (Italy), Università Telematica degli Studi IUL (Italy), Ministry Of Science And Education Of The Republic Of Croatia (Croatia), Ministério da Educação – Direção-Geral da Educação (DGE) (Portugal) and University Of Cyprus.

When - 2019-2022

Where - Europe

Good practice - The 'Integrated STEM Teaching for Primary Schools' MOOC is relevant to primary school teachers of all levels of experience who are interested in learning how to go from teaching isolated Physics, Chemistry, Biology, Science, Technology, Engineering and Mathematics classes, to a real integrated STEM teaching of these topics, not only among themselves but with all other disciplines. This MOOC will examine the opportunities offered by integrated STEM teaching and will provide many practical examples. The 'Integrated STEM Teaching for Secondary Schools' MOOC aims to provide secondary school teachers with essential skills and knowledge to go from isolated Physics, Chemistry, Biology, Science, Technology, Engineering and Mathematics classes, to a real integrated STEM teaching of these topics. And not only among themselves but with all other disciplines. Furthermore, you will be able to explore exemplary STE(A)M integrated lesson plans created and tested by other teachers, and many more relevant resources.

Recommendation

The MOOCs remain open for self-study through: Integrated STEM Teaching for Secondary Schools (rerun, EN)

Would you like to know more about integrated STEM and to prepare yourself for the course? Read about:

- The integrated STEM learning scenarios ("http://steamit.eun.org/category/integrated-stem-learning-scenarios/")
- The STE(A)M IT Repository of STEM Jobs Profiles ("http://steamit.eun.org/category/stem-careers/")
- The Integrated STEM Teaching State of Play ("http://steamit.eun.org/integrated-stem-teaching-state-of-play/")
- The guidelines on how to present STEM jobs in classrooms ("http://steamit.eun.org/guidelines-on-how-to-present-stem-jobs-in-classrooms/")
- Learning Scenarios for Secondary Education ("https://steamit.eun.org/category/integrated-stem-learning-scenarios/secondary-education/")
- Master ("https://steamit.eun.org/category/level-of-study/master/")
- Mathematics ("https://steamit.eun.org/category/main-field/mathematics/")
- NBS project ("https://steamit.eun.org/category/contributors/nbs-project/")
- Online and face-to-face certified courses ("https://steamit.eun.org/category/level-of-study/online-and-face-to-face-certified-courses/")
- PhD ("https://steamit.eun.org/category/level-of-study/phd/")

- Publications ("https://steamit.eun.org/category/publications/")
- Repository of STEM Jobs Profiles ("https://steamit.eun.org/category/stem-careers/")
- Science ("https://steamit.eun.org/category/main-field/science/")
- Space Awareness ("https://steamit.eun.org/category/contributors/space-awareness/")
- STEM Alliance ("https://steamit.eun.org/category/contributors/stem-alliance/")
- Stories of implementation ("https://steamit.eun.org/category/stories-of-implementation/")
- Stories of implementation primary ("https://steamit.eun.org/category/stories-of-implementation/stories-implementation-primary/")
- Stories of implementation secondary ("https://steamit.eun.org/category/stories-of-implementation/stories-implementation-secondary/")

Handbook for Career Advisers

Integrated STEM teaching aims to introduce students to STEM topics (Science, Technology, Engineering and Mathematics) in a connected manner and to contextualise STEM in the real world by highlighting examples of STEM jobs and careers that can inspire students. To achieve this, the project created the Career Advisers Network to help teachers better understand the career pathways that are available to students and the skills they require while nurturing a strong relationship with the STEM Industry. The purpose of the handbook for career advisers is to reach out, inspire and support teachers and the wider community of school career advisers and was authored by teachers of all levels of education who are members of the Career Advisers Network. The handbook includes best practices and guidelines on how to contextualize STEM careers in the classroom, strategies on how to better understand students' needs to put them on a STEM career path, and ways to initiate or enhance connections with the STEM industry.

The handbook for career advisers is part of the first European Integrated STEM teaching Framework produced by the STE(A)M IT project, a project funded with the support of the Erasmus+ programme of the European Union. (http://files.eun.org/STEAMIT/STEAMIT_Handbook_Career_Advisers_01.pdf)

5.4 GoScience - ENHANCING COMPREHENSION ERASMUS PLUS FUNDED PROJECT

General description - The aim of the project is to develop youth culture of gaining comprehension in science subjects (mathematics, physics, chemistry, biology) as well as to promote students' creativity, thus making scientific knowledge better understandable and with higher probability of implementing it in real life. The idea of the project is to develop methodology and pedagogical tools for science teaching and learning focused on coherence of the educational content with the comprehension model of students. This will allow science education in schools to be more motivating, open and students to have greater responsibility for their own learning process. The tools and methodology combine the best of several pedagogical approaches (as constructivism, connectivism, peer-learning) and focus on comprehension which is usually not the central point of the currently used pedagogical tools and practices, since they focus on the role of the teacher and motivation of students. The project aims at creating intellectual products that will allow teaching and learning sciences in any school, despite the curricula, type of school, grade the pupils are in, etc. The project outputs give the teachers the freedom to relate concepts in scientific subjects, which often are situated in different grades in the curricula for students to study, which make students forget and lose the connection between the different knowledge units, which decreases their comprehension and functional literacy and leads to serious underachievement in the science subjects, which also is a reason for students not having the ability to work on development of transversal competences in the future. Under the project, teachers will acquire new competences and skills to address students' under achievements and work not only for the forming of basic knowledge and skill of sciences, but also for the forming of transversal

competences - development of creativity, adaptation to the rapidly changing circumstances, intercultural competences, social development, "learning to learn" competences and an improved perception of one's own capacity to solve problems.

Key Words: comprehension in science subjects (mathematics, physics, chemistry, biology) , youth creativity, transversal competences

Who - Leading partner - Professional High School "Dr. Asen Zlatarov" - PGAZ (Bulgaria) **Website:** http://www.pgaz.org

When - 2017-2019

Where - European Union

Good practice

Development of methodology for enhancing comprehension in science education in high schools

Result: The methodology is the corner stone to build and implement a systematic approach for science teaching and learning focused on comprehension and on active student involvement in the educational process. Currently scientific topics are explained through scientific language, which hampers the understanding of kids; their educational success in sciences is mainly related to the word skills of the teachers and their ability to explain. The problem is that no matter how close teachers try to be to the conscious, cognitive and thinking models of kids they usually fail for the fact that the neurological connections in their brains, their experience and knowledge, are very different from these of the kids.

The innovative character of the methodology developed under the project can be found in its main characteristics:

- It focuses on comprehension which is not the central point of the currently used pedagogical tools and practices in sciences, since they focus on the role of the teacher and motivation of students;
- It focuses on active student involvement in the education process – students have to work themselves for the creation of variety of pedagogical tools using their creativity and fantasy;
- It focuses on using associative images, models, art representation of science concepts, which create coherence of the educational content with the comprehension model of students, relating the content to natural and familiar phenomena;
- It requires a process of ensuring scientific relevance of all the created pedagogical tools;
- It will give the teachers the freedom to relate concepts in scientific subjects, which often are situated in different grades in the curricula for students to study, which make students forget and lose the connection between the different knowledge units, which decreases their comprehension and functional literacy and leads to serious underachievement in the science subjects;
- It will makes possible the use of pedagogical tools not necessarily based on language, which allows teachers to address and students to use not only their verbal skills but all their senses, abilities, emotions (thus making the process of understanding and remembering much more effective);

Recommendation

Teachers Training

The ability to comprehend is probably one of the most important abilities of people. Comprehension can be worked on, developed, improved as any other ability we have. It is not only important but crucial for the education process, since it is responsible for the most difficult task - to pass on particular agreements, different notions, processes and concepts not as a formal text, but in a manner that these notions and concepts find their place among other concepts already existing in the students' knowledge database, relate to them and most of all be understood in a way, which will allow them to be further applied in everyday life.

The training organized under the GoScience project will focus on giving the science teachers knowledge and skills to use and implement in their practice an innovative methodology for enhancing comprehension in science education in high schools.

Day 1_GoScience_Comprehension and literacy_MM.pptx *(397,1 kb)* **("https://goscience.eu/download/Teachers%20training/1/Day%201_GoScience_Comprehension%20and%20literacy_MM.pptx")**

Day 1_GoScience_Enhancing listening comprehension_MM.pptx *(395,4 kb)* **("https://goscience.**

eu/download/Teachers%20training/1/Day%201_GoScience_Enhancing%20listening%20comprehension_MM.pptx")

Day 1_GoScience_Enhancing reading comprehension_MM.pptx *(462,5 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%201_GoScience_Enhancing%20reading%20comprehension_MM.pptx")

Day 1_GoScience_Methods and instruments for enhancing comprehension_MM.pptx *(465,2 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%201_GoScience_Methods%20and%20instruments%20for%20enhancing%20comprehension_MM.pptx")

Day 1_GoScience_Vocabulary in science education_MM.pptx *(396,3 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%201_GoScience_Vocabulary%20in%20science%20education_MM.pptx")

Day 2_Examples of models_UH.pdf *(704,3 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%202_Examples%20of%20models_UH.pdf")

Day 2_GoScience_recognition and memory_RV.ppt *(360,4 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%202_GoScience_recognition%20and%20memory_RV.ppt")

Day 2_GoScience_understanding of everyday awareness and scientific concepts_UH.pptx *(1,8 mb)* ("https://goscience.eu/download/Teachers%20training/1/Day%202_GoScience_understanding%20of%20everyday%20awareness%20and%20scientific%20concepts_UH.pptx")

Day 2_activity_forming term chain_UH.pdf *(197,3 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%202_activity_forming%20term%20chain_UH.pdf")

Day 3_GoScience_methodological recommendations for using the models_UH.pptx *(1,3 mb)* ("https://goscience.eu/download/Teachers%20training/1/Day%203_GoScience_methodological%20recommendations%20for%20using%20the%20models_UH.pptx")

Day 3_GoScience_reality and how we can remember_RV.ppt *(391,7 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%203_GoScience_reality%20and%20how%20we%20can%20remember_RV.ppt")

Day 3_Planning the lesson.pdf *(11,3 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%203_Planning%20the%20lesson.pdf")

Day 4_GoScience_assessment criteria for models_UH.pptx *(117,1 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%204_GoScience_assessment%20criteria%20for%20models_UH.pptx")

Day 4_GoScience_models theory_RV.ppt *(1,1 mb)* ("https://goscience.eu/download/Teachers%20training/1/Day%204_GoScience_models%20theory_RV.ppt")

Day 4_activity_working out assessment criteria of a model_UH.pdf *(8,3 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%204_activity_working%20out%20assessment%20criteria%20of%20a%20model_UH.pdf")

Day 5_GoScience_use of analogies_art_drama_science concept maps_MM.pptx *(419,9 kb)* ("https://goscience.eu/download/Teachers%20training/1/Day%205_GoScience_use%20of%20analogies_art_drama_science%20concept%20maps_MM.pptx")

GoScienceEN_Training agenda_Bulgaria Oct 2018_final.docx *(399,9 kb)* ("https://goscience.eu/download/Teachers%20training/1/GoScienceEN_Training%20agenda_Bulgaria%20Oct%202018_final.docx")

GoScience_Training agenda_Bulgaria Oct 2018.pdf *(605,4 kb)* ("https://goscience.eu/download/Teachers%20training/1/GoScience_Training%20agenda_Bulgaria%20Oct%202018.pdf")

GoScience_project presentation_MM.pptx *(415,7 kb)* ("https://goscience.eu/download/Teachers%20training/1/GoScience_project%20presentation_MM.pptx")

5.5. SCHOOLS TUNE INTO MARS (STIM) ERASMUS+ FUNDED PROJECT

("https://ec.europa.eu/programmes/erasmus-plus/node_en")

General description - The Schools Tune Into Mars (STIM) project aims to improve effective and quality teaching of mathematics, science, engineering and technology (STEM) disciplines at secondary level and to increase young Europeans' knowledge, skills and interest in STEM education.

https://www.europeanschoolnetacademy.eu/courses/course-v1:STIM+Mars_Mission+2020/about

In this regard, the proposed School Tune Into Mars (STIM) partnership will in particular aim at the development of transversal

competencies, strengthening networks of science-connected teachers and different actors (institutions and experts) who are already engaged in science community, in order to exchange teaching practices related to the Space mission InSIGHT "Discover the inner structure of Mars to better understand the Planet Earth".

https://insight.oca.eu/fr/stim-resources(link is external)

Keywords - STEM

Who - Schools Tune Into Mars was initiated as a multi-stakeholder project funded by the Erasmus+ Programme. The STIM School Label is a joint initiative of Lycée International de Valbonne, France, European Schoolnet, Belgium. Asociación Española para la Enseñanza de las Ciencias de la Tierra, Spain. National Institute for Earth Physics, Romania.

Duration: 2018 - 2021

Social media:

Twitter: @STIMerasmus

Good practice

The *Schools Tune Into Mars* MOOC will offer real, first-hand data and provide tools to STEM teachers who would like to explore Mars missions and their ramifications for our lives on Earth together with their students.

5.6 MICRO - AND PROJECT-BASED LEARNING PROGRAMME FOR TEACHING CIRCULAR ECONOMY AND ECOLOGICAL AWARENESS IN VET (TREE) ERASMUS PLUS FUNDED PROJECT

General description - TREE project was designed to effectively respond to the context and the challenges of Circular Economy.. In particular, TREE project will address the following needs:

Provision of common definitions of "green skills" for the plastics, wood and agrifood sector;

Provision of training for teachers to implement ESD in VET institutions; Increase of VET students environmental awareness and "green skills"; Integrating the teaching of ESD in VET institutions to provide "green skills";

Harmonization of educational policies for promotion of the green transition and the CE;

Establishing closer cooperation between businesses and VET institutions. Key Words

Who - **Coordinator** VsI "eMundus" Lithuania, Website:

("https://www.emundus.eu/")

Phone: +37061650453

When - Start date 01-12-2021/ End date 30-11-2023

Where - Europe

Good practice

The transnational report is based on a desk and field research that was carried out in all partners' countries (i.e. Lithuania, the Netherlands, Estonia and Bulgaria). It represents a comparative study on what emerged from the first phase of research.

1. It contains relevant information about: what is Education for Sustainable Development (ESD): definition, applicability and use in partner countries
2. Sustainability: partner countries approach and priorities

3. Partner country's policies and Circular economy State of the Art in partners' countries

4. Questionnaires and semi-structured interviews results ("field research")-both quantitative and qualitative data

5. Review of VET schools-current status, educational priorities and Green skills. Review of sectors included in the TREE Project within partner country (plastic sector, agrifood sector, wood sector)

("https://ec.europa.eu/programmes/erasmus-plus/project-result-content/21698d64-deb8-4767-aeea-a71fc1af5f37/Transnational-report-_TREE.pdf")

Recommendation

TREE partners developed a Database, as part of the TREE Platform. In the Database partners collected virtuous examples of national and international companies, NGOs, VET schools that are active in the filed of sustainability and circular economy (especially in the project's economic sectors of interest: plastic, agrifood, wood). Moreover partners developed a database for events related to the project's topics in all partners countries. The aim of the database was: 1) to create a con-

nection between different organizations: companies, schools, etc. 2) to inform people about events related to sustainability within partners' countries. https://treeproject.eu/tree-database/

5.7 OVERSEAS PRACTICE THE NATIONAL MATH AND SCIENCE INITIATIVE

NMSI x The IF/THEN AAAS Ambassadors Collection Highlighting Diverse Women in STEM Curriculum Assets for Middle School, High School and AP® Educators

Inside this document, you'll find numerous resources for your 6th – 12th grade students and classrooms as ambassador collection.

https://www.nms.org/getmedia/40745462-ef97-4355-8343-09c7e7ad4cde/NMSI_ IfThen_Collection_Assets.pdf.aspx

"*We, humans, learn by example, so by providing access to these role models with their personal stories and struggles, we offer girls a great insight on what their future in STEM can be. As we often say, if you can see something, then you can become it*", added

Evita Tasiopoulou, STEM Project and Pedagogical Manager at European Schoolnet.

Top 60 European Women transforming the Agrifood Sector

("https://www.eu-startups.com/2024/03/top-60-european-women-transforming-the-agrifood-sector-sponsored/")

CONCLUSION

Currently, women make up only 28% of the global workforce in science, technology, engineering, and math (STEM), with men outnumbering women in most STEM fields in secondary education and occupations. The gender pay gap in STEM is particularly pronounced in Engineering (21%), Computer Science (19%), and ICT. This is a significant issue for women in the EU, as these fields are among the fastest-growing, highest-paid, and offer substantial opportunities for career advancement and success. One contributing factor is the lack of inclusivity and diversity in the educational environment, which fails to address gender-based biases (women are often perceived as less capable and underperforming compared to men in STEM fields). This perception diminishes the motivation of women and girls to pursue secondary education in these areas and related careers.

Key factors include facing gender stereotypes and prejudice, the underestimation of women's skills in STEM, exclusionary and inflexible male-dominated environments in STEM education and workplaces, and a lack of female role models such as female engineers and computer scientists. Through GGG project, we aim to address these issues and support the partnership's goals by promoting and encouraging greater participation of women in STEM secondary education and careers. Our objectives include motivating women to enter these fields, eliminating gender-based stereotypes and prejudices regarding their abilities and potential for success, and creating a more supportive, tolerant, and diverse STEM educational environment. The project will benefit target groups, including girls pursuing or considering STEM education and careers who are often discouraged due to persistent underestimation of their abilities. Additionally, parents and experts such as psychologists, trainers, youth workers, and career counselors working directly with these women to increase their participation in STEM will also benefit from the project.

The coming years will be crucial in terms of societal and digital transformation, with the STEM sector seemingly dominating. Fighting for gender equality and parity is also about ensuring that everyone can access the new knowledge that will build our future. That means creating new opportunities, democratising education, raising awareness at a young age, and deconstructing stereotypes at home and in the classroom.

According to **Dr Agueda Gras-Velazquez**, "STEM is present in virtually all aspects of our lives. That is why we believe everyone should have access to STEM education, emphasising the value of Science, Technology, Engineering and Mathematics. This year, we encourage every educational stakeholder to organise events and activities that raise student awareness and make STEM accessible to everyone, showcasing key skills that students and our societies will need in the near future".

Closing the gender gap in STEM disciplines is crucial, not only for achieving gender equality but also for advancing science and technology. Stories of successful women in these fields demonstrate that overcoming these barriers is possible and beneficial for everyone. For instance, Gwynne Shotwell, president and COO of SpaceX, has significantly contributed to the company's growth and success in spaceflight and commercial space transportation. With a background in mechanical and thermal engineering, Shotwell is regarded as one of the most influential figures in the modern aerospace industry. Her work has pioneered new frontiers in commercial space exploration, making her a prominent woman in STEM today.

However, despite the increasing number of such examples, a collective effort is needed to create more inclusive educational and work environments. This commitment must involve everyone, especially men, who currently hold many positions of power often attained not only by merit but also due to an inherent bias against women. Through education, awareness, equitable policies, and support for women in STEM, we can not only bridge the gender gap but also enhance the scientific and technological fields with diverse perspectives and innovations.

Global Green Skills Report 2022

https://economicgraph.linkedin.com/content/dam/me/economicgraph/en-us/global-green-skills-report/global-green-skills-report-pdf/li-green-economy-report-2022.pdf?trk=eg_fow_grn_nav

Scientix ("https://economicgraph.linkedin.com/content/dam/me/economicgraph/en-us/global-green-skills-report/global-green-skills-report-pdf/li-green-economy-report-2022.pdf?trk=eg_fow_grn_nav") project, through numerous webinars ("https://www.youtube.com/watch?v=4Ue9-NHLqTE") and workshops for parents and teachers, helps them understand the power of stereotypes ("https://www.youtube.com/watch?v=DQNEH7Spqwg"), learn how to identify them and gradually eliminate them .

European Schoolnet's STEM Discovery Campaign ("http://www.eun.org/stem-discover-campaign-2022") is one of many initiatives and educational programmes focused on STEM education that promote diversity and inclusion.

This international initiative invites projects, organisations, schools, and other stakeholders to promote careers and studies in this field by organising and supporting STEM-related activities.

ANNEX | BEST PRACTICES

GREECE

1. WESTEMEU

(https://www.interregeurope.eu/westemeu)

General Description: WeSTEMEU is a project under the Interreg Europe program that aims to improve the rate of women with STEM (Science, Technology, Engineering, Mathematics) careers in the territories of its 9 participating institutions. It is 4 years project (from 2023 to 2027) and it involves the participation of institutions from Ireland, Greece, Romania, Spain, Poland, and Lithuania. It is co-financed by the European Regional Development Fund (ERDF) and has a total budget of 1.6 million euros.

Green Skills Focus: WeSTEMEU contribute to ameliorating the gender imbalance and thus making the STEM sector more responsive to the social, economic, and environmental needs of both genders. Concurrently, this give rise to meeting the demands for jobs growth and innovation for sustainable development in the current knowledge-based economy. At the same time, by facilitating women´s active participation in the sector, the projects´ long-term impact will also be evident in terms of the pay-gap, as women enter jobs that are more highly paid than those in traditionally female sectors.

Social Media: YouTube: https://www.youtube.com/watch?v=aOF9TJWesT8| X: @WeSTEMEUproject

- **Who:** Interreg Europe / Computer Technology Institute & Press "Diophantus" (GR)
- **Email (for Greece):** m.michopoulou@pde.gov.gr
- **When:** 2023-2027
- **Key Words:** STEM, Women, Gender Gap, Employment

2. CODEGIRLS

(https://mataroa.org/codegirls/)

- **General Description:** It is an interactive new technology and programming learning program for girls aged 10-16, developed and used by Mataroa, with the valuable support and sponsorship of the US Embassy in Greece. Mataroa organizes workshops for young girls in different cities in Greece.
- **Green Skills Focus:** The goal of CodeGirls is to close the gender gap in the fields of technology and IT, with the aim of educating, inspiring and equipping girls with skills and means. We achieve this by Introduction to the basics and logic of hardware and software, Training in in-demand programming languages and development technologies and Professional Orientation and Guidance.
- **Social Media:** Facebook: https://www.facebook.com/Mataroa.org LinkedIn: https://www.linkedin.com/company/mataroa/
- **Email:** info@mataroa.org
- **Who:** Greek NGO "Mataroa"
- **When:** 2018-present
- **Key Words:** Technology, Coding, Mentorship, Sustainability, Girls

3. GREEK WOMEN IN STEM

(https://greekwomeninstem.com/gr/)

- **General Description:** This project aims to convey the research work of Greek women to the public through interviews with the researchers themselves, summaries of their publications, or through special seminars / lectures to highlight their role and to inspire young women to engage with a career in STEM.
- **Green Skills Focus:** There are podcasts, seminars and interviews focused on environmental problems and sustainability, green energy and jobs of the future.
- **Social Media:** Facebook: https://www.facebook.com/GreekWomeninSTEM | LinkedIn: https://www.linkedin.com/company/greek-women-in-stem/ X: @GR_WomenSTEM
- **Email**: greekwomeninstem@gmail.com
- **Who:** Greek Women in STEM
- **When:** 2017-present
- **Key Words:** STEM, Environment, Girls, Jobs, Sustainability

4. ROBOGIRLS

(https://www.robogirls.eu/el/)

- **General Description:** The RoboGirls project aims on building the capacity of educators to organise and implement innovative, experiential STEM activities and events with the use of robotics and coding to narrow the gender gap, empower, encourage and actively engage girls to green and digital technologies so to be able to act and play an active role in the digital age.
- **Green Skills Focus:** The robotics projects are centered around environmental themes, encouraging participants to innovate with sustainability in mind.
- **Social Media:** Facebook: https://m.facebook.com/RoboGirlsproject
- **Who:** National Technical University of Athens
- **When:** 2021-2023
- **Key Words:** Robotics, Green Technology, STEM, Girls, Innovation

TURKEY

1. KIZCODE:

(https://www.kizcode.org)

- **General Description:** KızCode is an initiative that aims to teach coding and technology skills to girls from disadvantaged areas.
- **Green Skills Focus:** There are environmental consciousness and green technology topics in the curriculum and girls are being encouraged for developing sustainable solutions.
- **Social Media:** Instagram: kizcode X: @kizcode
- **Who:** Müjde Esin
- **When:** 2015- present
- **Key Words:** Girls, Disadvantages, Coding, STEM

2. STEM VE MAKERS FEST/EXPO:

(https://stemandmakers.org)

- **General Description:** This event which is held every year puts students, teachers and families together from all around Türkiye. Special workshops

and seminars are being organised for schoolgirls.

- **Green Skills Focus:** Projects and presentations are being done about topics such as renewable energy, recycling and sustainable agriculture in the event.
- **Social Media:** Instagram: stemmakersfest
- **Who:** the European Union, Hacettepe University
- **When:** 2017-present
- **Key Words:** Projects, Presentation, STEM

3. FRC TÜRKIYE:

(https://www.frcturkiye.org)

Contribution to STEM Education:

- **General Description:** FRC provides practical experience in robotics and engineering fields to students. In this way, it helps students improve their technical skills.
- **Encouragement for Girls:** Program encourages girls' participation in STEM fields and encourages them being active in fields such as engineering, programming and project management.

Green Skills and Sustainability:

- **General Description:** Students design and build their robots to complete specific tasks. These tasks are generally based on real world problems and can contain sustainability topics.
- **Green Projects:** Topics such as environmental themes and energy efficiency are covered in the competitions. While designing their robots to develop sustainable solutions, students adopt environmentally friendly approaches.
- **Social Media:** Instagram @fyukselfound
- **Who:** Fikret Yüksel Foundation
- **When:** 2016-present
- **Key Words:** Engineering, Robotics, Social Projects, Sustainability, STEM, Cooperation

4. TÜBİTAK SCIENCE AND PUBLIC PROJECTS:

(https://tubitak.gov.tr/tr)

- **General Description:** The Scientific and Technological Research Council of Turkey (TÜBİTAK) funds various educational projects to increase scientific literacy among young people, and there are also special programs for girls.
- **Green Skills Focus:** Many projects focus on sustainability, climate change and green technologies, and girls are encouraged to pursue careers in these fields.
- **Social Media:** Instagram: tubitak X: @Tubitak
- **Who:** TÜBİTAK
- **When:** 1970-present
- **Key Words:** Project, Science, Green Technology, STEM

5. FLL TÜRKIYE:

(https://bilimkahramanlari.org/fll-explore/)

- **General Description:** Introduces STEM to children ages 6-10 through fun and exciting hands-on learning. Participants gain real-world problem-solving experiences through a guided global robotics program so today's students and teachers build a better future together. FLL's three divisions encourage youth to experiment and develop critical thinking, coding and design skills through hands-on STEM learning and robotics.
- **Green Skills Focus:** Themes such as environmental issues and efficiency covered in the competitions aim to encourage children to think creatively by integrating their experiences in green skills and STEM fields.
- **Social Media:** Instagram: bilimkahramanlari X: @BilimKahraman
- **Who:** Bilim Kahramanları Foundation
- **When:** 2010-present
- **Key Words:** STEM, Robotics, Cooperation

6. STEM FOR DISADVANTAGED STUDENTS ESPECIALLY GIRLS:

(https://www.aydin.edu.tr)

- **General Description:** It is a project that aims to increase the interest of especially disadvantaged girls in STEM and to contribute to their choice of profession in this field, to make them love science and to make them understand the interaction between science, technology, society, environment and the individual.
- **Green Skills Focus:** In the trainings within the scope

of the project, it is aimed to raise environmental awareness among students by teaching STEM fields together with environmental issues.

- **Social Media:** Instagram: iaukampus X: @IAUKampus
- **Who:** İstanbul Aydın University
- **When:** 2014-2016
- **Key Words:** STEM, Girls, Environment

BULGARIA

1. SCHOOL STEM CLUB AND SCI HIGH STEM FEST

- **General Description:** School STEM Club is an initiative of Sci-High non-governmental organisation. It aims to create STEM secondary school clubs in as many as possible schools according to the author's program and with the financial support of Sci-High and coordinated by the HALO Foundation. At the end of each school Sci High Fest is organised.

(https://www.facebook.com/hashtag/scihighfest?locale=bg_BG)

- On the June 15, 2024, the National Sci High STEM Fest was held at SU's Faculty of Biology! The event attracted 150 people of different ages and cities, who had the opportunity to immerse themselves in the world of science and feel the research spirit. The stands of student teams from Knezha, Kozloduy, Haskovo and Sofia presented topics from various fields - from "Garbage collection and recycling", through "Water purification", "Harmful dyes in food", "Hydrogen fuels" to "Tobacco smoking", "Demographic crisis in Bulgaria" and "Conservation of the Eurasian Lynx". All participants showed curiosity, a desire to contribute to the community and nature, and enormous courage.

Two teams that won awards:

- Jury prize for the best presentation of a research project was won by the team of PGZ "Stefan Tsanov", Knezha for their extremely well prepared and presented project "Lack of diversity and sustainability of agricultural crops", in which they introduced the audience to an important topic in the field of agriculture, namely - how rich Bulgaria is in local varieties and how important it is that the crops used by local farmers are selected in Bulgaria to be more resistant to the conditions and climate here.

- The audience award for the best research stand went to the spectacular "Molecular Kitchen" project of the students of "St. St. Cyril and Methodius" SU - Kozloduy, who impressed the visitors with a wonderful stand, excellent communication skills and both scientific and business perspective in your project.

Prizes for winners include:

- Annual subscription to "BG Nauka" magazine
- Visit to Muzeiko and their planetarium
- Visit to a high-tech laboratory of IBM Bulgaria
- Each participant who reaches the national festival also receives a certificate of achievement for the successfully completed academic year in the Sci High science club. The Fest partners include IBM, Bulgarian Science, HALO Foundation, Muzeiko, as well as to the employees of PhoneArena and WMWare, now part of Broadcom, SU „St. Kliment Ohridski" - Faculty of Biology

#SciHigh2024 #STEMfest #БъдещетоНаНауката #SciHigh , #scihighfest

("https://www.facebook.com/hashtag/scihigh2024?__eep__=6&__cft__%5B0%5D=AZUbpOA3mj2vRMtGe2kgCnSdecatA7p0gxm3tWjaHGCVwdiFK1dXISm49fWpHuCjQRZKx1NEEJIAHglqw3DJIpvImIwX-BPaAW4F8MAl2hOnY8R5RQVutnm2rUIGEoreVn0Mc5W2PaZq7dWKkiTzLW804Vm0nJkRmldpcTpgywms_R-17CFHWWjSFPvUQNFuhkOHXMdLwqYO4XtOWesI2b45&__tn__=*NK-R)

- **National Science and Mathematics High School „Acad. Lyubomir Chakalov" (official) 119.**
- **SU „Acad. Mihail Arnaudov" 97.**
- **SU „Bratya Miladinovi"**
- **PGZ „Stefan Tsanov"**
- **SU „St. St. Cyril and Methodius" - Kozloduy**
- **96 SU with study of foreign languages „L.N. Tolstoy" - city of Sofia**
- **GPCHE „Asen Zlatarov" Haskovo / FLS „Assen Zlatarov" Haskovo**
- **FLS "Assen Zlatarov" Haskovo**

Green Skills focus: The STEM clubs deal with sustainability and green topics in all sfephes of life and economy;

- **Social Media:** https://www.facebook.com/hashtag/sci-highfest
- **Who:** Sci High NPO
- **When:** 2024
- **Key Words:** STEM, future of science, green transition, circular economy.

2. STEMFEM JUNIOR

- **General Description:** A1 – mobile operatör- has launched its STEMfem Junior mentoring program, designed for school-aged girls who are studying and excited about technology, engineering and maths.

The initiative includes 11th and 12th grade students who study in specialties such as system or applied programming, computer networks, mathematics and informatics, software and hardware sciences. STEMfem Junior aims to support girls who are interested in the technological field and want to continue their development in it.

„As a technology leader, we want to attract young girls to the exciting world of science and innovation. Our goal is to give an equal career opportunity to young ladies - the future technology leaders, and through STEMfem Junior they will get the necessary practical environment in which to demonstrate and develop their potential," says Miglena Uzunova-Tsekova, Senior Director of Human Resources at A1 Bulgaria.

During the program, female participants will have the opportunity to participate in business and technical trainings, as well as in exciting seminars to upgrade social skills. The girls will have individual meetings with mentors – highly qualified women in their field, with whom they will work on various projects in order to gain practical experience in the technological field.

Specialists will also work with the students to help them choose a profession and a specific direction in technology.

STEMfem Junior will be held in person from July 15 to September 15 at the central office of A1 in Sofia. All participants will receive a certificate at the end of the program, and the best among them will be invited to an internship at A1 and will receive funding for further studies at a university.

To be approved for the program, applicants must apply. They need to fill out a form by June 20. The girls who advance in the selection process will be invited to an interview with the mentors from the program to share about their motivation and desire to develop in the world of technology.

The program aims to encourage them to practice the skills acquired in school, thereby building even more confidence in their abilities.

What does the program give you?

All participants will receive a certificate for successfully completing the program, and the best will receive an internship opportunity at A1, as well as financial support for continuing education.

- **Green Skills Focus:** Teaching STEM skills along with social skills
- **Social Media:** https://jobs.a1.com/bg/a1-stemfem-junior/
- **Who:** A1 mobile operator
- **When:** 2024
- **Key Words:** STEM, future of science, green transition, circular economy.

3.TRAINING GIRLS IN DESIGN AND CONTENT DEVELOPMENT IN WEB 2.0 PLATFORM

- **General description:** Edutechflag.eu trains girls in design and content development in web 2.0 platform through the programme Girls in ICT organized by the European Commission and ITU. Edutechflag has also organized the Super Digital Homework workshop and was Lead Local Facilitator of International Girls in ICT Day 2018
- **Green Skills Focus:** In the trainings within the scope of the initiative , it is aimed to raise environmental awareness among girls by focusing on the environmental impact of the technologies.
- **Social Media:** Facebook: https://www.facebook.com/groups/932327364207626
- **Who:** https://edutechflag.eu
- **When:** 2018-2019
- **Key Words:** STEM, Girls, Environment

• **Electronic Platform for Science Education in Secondary Schools** is based on the open-source Moodle learning platform for both teachers and students.

• **Equality Pays Off** supports large companies in diversifying the pool of (potential) employees by gaining better access to the female labour force.

FOR PREFACE MOTIVATION

Young Girls in STEM - Essay by Sofia Anderson

https://council.science/bg/news/young-girls-in-stem-an-essay-by-sofia-andersson/

This week, Sophia Anderson, a fourteen-year-old student from Ecole Internationale Bilangue, Paris, France, joined ISC as part of an internship program to learn more about international science. We invited Sofia to write an essay on the International Day of Women and Girls in Science. Here are her thoughts.

This is a new era for women. Nowadays, we girls grow up hearing that we can do anything, be anything. Yet there are still not enough women in science, technology, engineering and mathematics (STEM) to create equality. Only 29% of STEM jobs are held by women. Why? Girls have just as much potential and just as much interest in STEM as boys. It's simple. Unconscious gender bias. People don't even realize they're doing it. Helen Chang, who is the studio head for the Minecraft franchise, said that when she was in school, „it wasn't popular for girls to be smart or to be interested in challenging subjects within STEM." There are social and cultural barriers that often prevent girls from entering STEM subjects and careers. Popularity is one of them. Another is the pressure to prove themselves in a room full of men while being viewed as an outsider.

I feel that all girls and boys when they are young are interested in STEM. Children want to build and create. But as time goes by, it becomes less and less equal. Girls are not encouraged in the same way as boys and, when given careers advice, girls are often told not to study STEM. The lack of support from parents and teachers is discouraging. The lack of female role models in the field they're interested in doesn't help either.

John Sheehan, a partner architect on the Microsoft Windows project, has a young daughter who is interested in math. He commented that although she enjoyed math, she stopped trying when she got older. He says there was an „underlying sense that society was telling her boys were better at math." Chang says she "went through a period of wondering whether (she) should pretend not to understand the subjects or go deaf so (she) would be liked." Girls face enormous social pressures, not only to be seen as „feminine" but also to prove themselves worthy, which means they have to work twice as hard in the classroom or in the workplace as men. Girls „feel a lot of pressure to prove their professional worth over and over" or even that employers automatically assume they won't cut it.

I believe that women and girls are just as capable as men, and that empowering young girls is critical if we are to create a sustainable future for our planet.

Sophia Anderson

One of the main points of gender equality that people always bring up is the pay gap. This extends into STEM as well, with female engineers earning an average of 16% less than male engineers doing the same job. This discourages young girls from pursuing careers and reinforces the idea that women are not as good as men in STEM fields.

But what are the consequences of fewer girls in STEM? To name a few: laboratory experiments almost exclusively use male rats, which means that the results can never really apply to women; medical research studies men and doesn't realize that women's bodies may react differently; the first generation of airbags were designed to protect grown men, meaning women and children would die on impact. In short, most of them could be avoided if there were women among the researchers and subjects.

So how do we get rid of these barriers? How to change the system? Like the problem, this is a simple answer,

but the implementation is difficult. We need to address the bias. We should try to transform the system to recognize the biases. We need to give young girls interested in STEM a safe and supportive environment to explore that curiosity, whether at school or at home. We need to show them role models so they know that what they want to do is possible and that it can be achieved.

That's especially relevant today, with the re-entry to Earth of NASA astronaut Christina Koch, who said she wants to inspire the next generation of female space explorers after growing up with few female heroes. Koch and her colleague Anne McClain were unable to take a scheduled spacewalk together due to NASA not having spacesuits for two women, reminding us that space is still a boy's game.

Not so, according to Nichelle Nichols, an actress and NASA diversity and recruitment fellow who says, "Science is not a boy's game. Science is not a game for girls. It's anyone's game."

I believe that women and girls are just as capable as men, and that empowering young girls is critical if we are to create a sustainable future for our planet.