Promoting Girls' Participation in STEAM: Guidelines for Teachers

This document is part of the Blooming Toolkit and aims at supporting teachers in designing, implementing and evaluating activities that can contribute to an increased participation of girls in STEAM.

The following step by step process is proposed:

1. **Read the document below and reflect on its main ideas, to understand**
    - the main causes of the gender gap in STEAM;
    - the types of actions that can support bridging this gap;
    - the risks to avoid, based on the research evidence.

2. **Choose one or more of the personal stories of women from the past in STEAM** and prepare an interesting and engaging activity, based on the video and on the associated documents.
    - Take into account that this is an opportunity for students to understand the contribution of women to STEAM

3. **Choose one or more of the scientific articles explained** in an accessible language in the Blooming Toolkit and design an interactive learning activity inspired by the corresponding lesson plans
    - Take into account that the activity can have multiple benefits, including:
        - Present role models to girls and illustrate gender equality to boys
        - Provide opportunities for girls to experience success in STEAM
        - Provide opportunities for all students to cooperate from positions of equality

4. **Observe the behaviour of students, both girls and boys**, during the activities and identify:
    - aspects of the activities that worked well and could be further emphasised;
    - aspects of the activities that did not work as expected and that you should change or avoid in the future;
    - needs that should be addressed in future activities.

5. **Go back at the recommendations below** and identify what other types of interventions you may choose, to further promote diversity and inclusion in STEAM

6. **Consider sharing your experience with colleagues and encourage them to proceed in a similar way.**

Why Focus on Girls in STEAM?

Achieving gender equality is a core value of the European Union, rooted in Article 2 of the EU Treaty. The EU Gender Equality Strategy 2020–2025 highlights the goal of creating a society where individuals, regardless of gender, have equal opportunities to pursue their chosen paths. This includes addressing gender disparities in STEM (Science, Technology, Engineering, and Mathematics), where women remain underrepresented.

Details about the gender gap in STEAM in the countries involved in the Blooming project, are available in the dedicated reports.

Understanding the Causes of the Gender Gap in STEAM

Based on the specialized scientific literature, we can identify three main types of causes for the gender gap in STEAM: structural discrimination, gender stereotypes, and low self-efficacy.

1. Structural Discrimination:

- The education system often reproduces mechanisms that enforce gender stereotypes, sometimes unintentionally and even with good intentions.
- Such discrimination limits girls' opportunities in STEM and can be perpetuated by cultural and societal norms.

2. Gender Stereotypes:

- Deeply ingrained societal beliefs associate technical and intellectual skills with men. These biases can discourage girls from pursuing STEM.
- Gender is a social construct, and societal stereotypes are learned and internalized by both men and women.

3. Low Self-Efficacy:

- Girls often lack confidence in their STEM abilities due to societal messaging and internalized stereotypes, leading to lower participation rates.
- The "glass ceiling" effect, self-fulfilling prophecies, and stereotype threats further hinder their progress.

Intersectionality

In understanding the gender GAP in STEAM it is important to consider that the combined effects of gender stereotypes, social status, and cultural factors create additional barriers for many girls.

Effective Strategies for Teachers

1. Cultivate a Supportive Environment:

- Foster an inclusive classroom that emphasizes equality, equity, rights, and free choice. Ensure that all students feel welcomed and encouraged to engage in STEM activities.

2. Address Gender Bias:

- Actively counteract stereotypes by showcasing diverse role models and providing examples of successful women in STEM. Highlight how mistakes are a natural part of learning and innovation.

3. Promote a Growth Mind-set:

- Encourage perseverance and emphasize effort over innate talent. Teach students to view challenges as opportunities for growth.

4. Design Inclusive Activities:

- Create learning experiences that integrate real-life applications of STEM and encourage collaboration. Ensure equal participation in both technical and non-technical roles within group projects.

5. Provide Targeted Support:

- Offer mentorship, resources, and structured guidance to build confidence and skills in STEM.

Ineffective Practices to Avoid

- Overemphasizing Stereotypes: Highlighting that women are underrepresented in STEM or frequently discussing gender disparities can reinforce negative perceptions. (Cheryan, Master & Meltzoff, 2015)
- Gender-Segregated Initiatives: Organizing "girls-only" STEM clubs may signal that girls require special accommodations or cannot compete with boys in STEM fields. Instead, create inclusive programs for all genders. (Hughes et al., 2013)
- "Pinkification" of STEM: Marketing STEM activities to girls using gendered stereotypes trivializes the subject and alienates those who do not conform to stereotypical "feminine" interests. (Abraham & Barker, 2023)
- Assuming Equal Treatment = Equity: Treating all students identically without addressing specific barriers faced by girls allows inequities to persist. (Hill et al., 2010)
- Overloading on Role Models: Overemphasizing "exceptional" women in STEM can create the perception that success requires extraordinary abilities or sacrifices. Introduce relatable role models with diverse career paths. (Betz & Sekaquaptewa, 2012)
- Praising Effort Without Supporting Skill Development: Solely encouraging girls to "try harder" without providing resources, feedback, or structured guidance may lead to frustration. (Dweck, 2006)
- Assigning Girls Non-Technical Roles in Group Work: Allowing girls to take on only organizational or creative roles reinforces stereotypes and limits their skill development. (Sadker & Sadker, 1994)
- Focusing Solely on Increasing Numbers: Increasing the number of girls in STEM without addressing the quality of their experience is insufficient. (Carlone & Johnson, 2007)
- Emphasizing "Innate Talent" Over Effort: Highlighting "natural genius" as a key to STEM success perpetuates the myth that STEM requires innate ability. Promote perseverance and learning. (Dweck, 2006)
- Ignoring Implicit Bias in Teachers and Peers: Teachers and peers may unconsciously discourage girls' participation in STEM through subtle cues. (Hill et al., 2010)
- Ignoring Intersectionality in STEM Interventions: One-size-fits-all approaches fail to address unique challenges faced by diverse girls. (Crenshaw, 1989; Ong et al., 2011)

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Blooming 5E Activity Planning Template

The 5E instructional model (Engage, Explore, Explain, Elaborate, Evaluate) structures inquiry so students move from curiosity to application and reflection. It supports inclusive, student-centred learning and aligns with the Blooming Guidelines by promoting equity, countering stereotypes, and scaffolding confidence.

Introduction to the 5E Model

The **5E instructional model** (Engage, Explore, Explain, Elaborate, Evaluate) was developed by BSCS Science Learning to support inquiry-based science teaching. It helps students build understanding step by step, starting from curiosity and moving toward application and reflection.

We propose using the 5E model for Blooming activities because:

- It creates **inclusive, student-centered learning environments** where all voices can be heard.
- It supports **equity in participation** by encouraging teamwork, exploration, and critical thinking.
- It helps counteract gender stereotypes by showing that success in STEAM comes from **collaboration, curiosity, and perseverance**, not "innate talent."
- It provides a **clear structure** for teachers to design, implement, and evaluate meaningful activities aligned with the Blooming guidelines.

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Blooming Activity Template

General Information

Teacher's Name: _____

School / Grade / Subject: _____

Date: _____

Activity Title: _____

Duration: _____

Targeted Causes of the Gender Gap

0) Prepare (before class)

Read & reflect on the Blooming Guide to clarify:

- causes of the gender gap (structural discrimination, stereotypes, low self-efficacy),
- actions that help bridge it,
- risks to avoid in practice.
  Keep a one-page note with: "Which causes does my activity target? Which risks must I actively avoid?"

☐ Structural discrimination
☐ Gender stereotypes
☐ Low self-efficacy
☐ Intersectionality

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1. ENGAGE — Spark curiosity & set an inclusive tone

Use these Blooming materials:

- Pick **one Personal Story of a woman from the past in STEAM** (video + docs) to launch the topic. Invite quick "notice–wonder" prompts so every student has a voice in the first 3–5 minutes.

✨ What are Notice–Wonder prompts?

They are a simple inquiry routine designed to help all students engage at the start of a lesson. Instead of asking for "right answers," you ask students two open-ended questions when they see a stimulus (a picture, a short video, a quote, a data chart, or in Blooming's case, the story of a woman in STEAM):

What do you notice?
– Students share objective observations ("She is working with early chemistry equipment"; "The article shows graphs about water pollution").

What do you wonder?
– Students share questions or curiosities sparked by what they saw ("How did she become a scientist when women weren't allowed in universities?"; "Why does the graph show such a sudden increase?").

Why use it in Blooming activities?

- It gives **every student a voice in the first 3–5 minutes**, setting a norm of equal participation.
- "Noticing" feels safe (anyone can describe what they see), while "wondering" values curiosity over correctness.

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- It helps girls build **confidence early in the lesson**—before technical tasks start.

- It naturally connects to the **historical stories** and **articles** from the Blooming Toolkit, anchoring them in curiosity instead of stereotypes.
How to implement in class (3–5 minutes)

1. **Present the stimulus**
   – Show the video/story of a woman in STEAM, or display the article's key image/quote.

2. **Think–Pair–Share**
   – Ask students to write down **one Notice and one Wonder** individually (1 minute).
   – Pair up to share with a partner (1 minute).
   – Take 2–3 volunteers per pair to share with the class (1–2 minutes).

3. **Teacher move**
   – Collect responses on the board in two columns: *Notices* and *Wonders.*
   – Highlight that all contributions are valid and will guide the activity.

Inclusion moves (from the Guide):

- Frame norms of *equality, equity, rights, free choice*; explicitly say "mistakes = part of learning."

- **Guardrails (what to avoid):**
  – Don't dramatise underrepresentation at the start (can reinforce stereotypes). (Cheryan, Master & Meltzoff, 2015)
  – Don't "pinkify" the hook or theme. (Abraham & Barker, 2023)
  – Don't imply STEM = "innate genius." (Dweck, 2006)

Evidence to capture: who volunteers first; balance of voices; affect (interest/confidence) notes.

ENGAGE material (Personal Story used; prompt):

How will I spark students' curiosity?

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How will I ensure girls feel immediately included and valued?

2. EXPLORE — Hands-on, shared roles, real data

Use these Blooming materials:

- Choose **one scientific article explained in accessible language** from the Blooming Toolkit and run the **interactive activity** inspired by its lesson plan. Students work in mixed groups with **rotating roles** (data, build, code, present), ensuring all genders take **technical and non-technical** tasks.

Inclusion moves (from the Guide):

- Design for collaboration and real-life applications; provide **targeted support** and scaffolds.

- **Guardrails:**
  – Avoid "girls-only" groupings; keep programmes inclusive. (Hughes et al., 2013)
  – Don't let girls default to organising/design roles only; rotate **technical** roles explicitly. (Sadker & Sadker, 1994)

Evidence to capture: time-on-task by role, who touches equipment, who records data, who decides next steps.

EXPLORE material (Article + lesson plan; group roles plan):

What hands-on or interactive activity will students do?

How will I organise groups so all genders share technical and non-technical roles equally?

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3. EXPLAIN — Make thinking visible; connect concepts & role models

Use these Blooming materials:

- Circle back to the **Personal Story** and the **Article**: have teams share findings, then connect their evidence to the STEAM concepts highlighted in the article summary. Use 2–3 **relatable** women role models (not only "exceptional" cases).

Inclusion moves (from the Guide):

- Address gender bias explicitly; celebrate perseverance and revision; normalise productive struggle.

- **Guardrails:**
  – Don't overload with "exceptional" icons (can feel unattainable). (Betz & Sekaquaptewa, 2012)
  – Don't praise effort **without** teaching strategies and giving feedback. (Dweck, 2006)

Evidence to capture: whose ideas are cited by peers; who explains results; language that attributes success to effort/strategy vs "talent."

EXPLAIN plan (concept connections + relatable role models):

How will students share their observations and insights?

How will I connect the activity to key STEAM concepts?

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4. ELABORATE — Extend to new contexts & widen participation

Use these Blooming materials:

- Use the article's **extension prompts** or design a mini-challenge that applies the concept to a local or societal problem. Invite students to **co-design improvements** to make the activity even more inclusive next time.

Inclusion moves (from the Guide):

- Revisit **intersectionality**—ask: "Who might still face barriers here?" Adjust roles/resources accordingly.

- Re-check the **Recommendations** list from the Guide and select **another intervention** (e.g., mentoring, showcasing diverse paths, community links) to integrate in a follow-up lesson or club.

Evidence to capture: which students propose improvements; shifts in willingness to try technical tasks; peer support moments

ELABORATE extension (new context; extra intervention to add next time):

How will students extend their learning (apply to new situations, connect to real-life problems)?

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5. EVALUATE — Assess learning and inclusion

Use these Blooming materials & steps:

- **Observe behaviours** (girls and boys): what worked, what didn't, what to change; document needs for future activities.
- Use quick checks (exit tickets, reflection prompts) for **concept understanding** and **sense of belonging/self-efficacy**.
- **Return to the Guide's recommendations** to choose further actions that promote diversity & inclusion.
- **Share your experience** with colleagues (short write-up, 5-slide brief, or 10-minute staffroom share).

EVALUATE plan (learning checks + inclusion evidence & observations):

How will I assess both learning outcomes AND inclusion outcomes?

What evidence will I collect (reflections, observation notes, peer feedback, products)?

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Teacher's Reflection

What worked well?

What challenges did I notice (especially regarding participation of girls)?

What will I change in the future?

How can I share this experience with colleagues?

Checklist (end-of-lesson audit):

☐ I avoided reinforcing stereotypes or "pinkifying." (Cheryan et al., 2015; Abraham & Barker, 2023)

☐ Roles were shared; no gendered task patterns. (Sadker & Sadker, 1994)

☐ I praised strategies and learning, not "genius." (Dweck, 2006)

☐ I used relatable, diverse role models. (Betz & Sekaquaptewa, 2012)

☐ I accounted for intersectional barriers. (Crenshaw, 1989; Ong et al., 2011

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Blooming 5E Teacher Worksheet (One Page)

Activity title / date / class:

Targeted causes of the gap: ☐ Structural discrimination ☐ Stereotypes ☐ Low self-efficacy ☐ Intersectionality

ENGAGE material: (Personal Story used; prompt)

EXPLORE material: (Article + lesson plan; group roles plan)

EXPLAIN plan: (concept connections + relatable role models)

ELABORATE extension: (new context; extra intervention to add next time)

EVALUATE: (learning checks + inclusion evidence & observations)

Share-out plan: (who/when/how)

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