

Promoting Gender Equality in STEAM through Innovative Educational Practices: Insights from the 'Blooming the Future' Project

Authors: Iro Koliakou, Eleni, Mangina, Tharrenos Bratitsis, Maria Kyriakidou, Dominique Persano Adorno & Calin Rus

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Project Identity

Blooming the future of STEAM: Promoting inclusion and diversity in STEAM for a sustainable future

Call 2022 Round 1 KA2

KA220-HED - Cooperation partnerships in higher education

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BLOOMING
Inclusion and Diversity in STEAM



**Università
degli Studi
di Palermo**

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Introduction

Blooming the Future Project

- Promotes inclusion and diversity in STEAM for students aged 14+ through innovative educational resources and teacher training.
- Aims to inspire young women to pursue STEAM careers by providing positive examples and role models.
- Best practice sharing among partner countries can enhance the pursuit of gender equity in STEAM across Europe.
- Network includes partners from Greece, Romania, Ireland, and Italy, offering online training and a digital storytelling book with stories of women in STEAM.

Research Methodology

Achieving Project Objectives

- Assess current diversity and inclusion in STEAM sectors across partner countries.
- Identify common challenges, unique circumstances, and innovative pedagogical approaches.
- Raise awareness on the importance of gender equality in STEAM sectors.

Research Methodology

- Scoping review approach used.
- Identify gaps in knowledge about gender equality in STEAM education and professions.

Key Research Questions

- Current challenges to closing the gender gap in STEAM fields.
- Opportunities related to gender equality in each partner country.
- Ways to promote gender equality in STEAM education and training.

Challenges: Findings on gender imbalance in education and workplace

Greece

- Family and/or social stereotypes deter girls from STEM.
- Female students are underrepresented in STEM faculties.
- Women face professional discrimination in STEM careers.

Ireland

- Only 25% of STEM workforce is female.
- Female STEM enrollments increased from 32.7% to 37.6% from 2015/16 to 2021/22.
- Gender imbalances at the post-primary level affect STEM career representation.

Italy

- Only 39% of STEM graduates are female.
- Gender stereotypes and professional discrimination persist.
- Gendered education choices lead to a dual male-female labor market.

Romania

- Females underrepresented in STEM: 20.25% vs 40.80% males.
- Less than 1% of Romanian women hold STEM jobs.
- Social perceptions and gender stereotypes hinder female interest in STEM.

Common themes and trends

Gender Stereotyping and Societal Perceptions

- Society favors boys in STEM and girls in humanities, reinforced by family and community.
- This affects girls' self-perception and interest in STEM, prevalent in Greece, Italy, Ireland, and Romania.

Underrepresentation of Women in STEM

- Women's participation in STEM education and professions remains low across all four countries.
- Despite some improvements in female enrollment, significant gender gaps persist.

Workplace Discrimination

- Women face discrimination in professional recognition and career advancement in STEM fields.
- Gender imbalance results in women not receiving due recognition despite high educational attainment.

Need for Female Role Models and Mentors

- Female role models and mentors are essential to encourage women in STEM.
- Emphasized in Greece, where female students seek support from female professors, but female faculty in STEM is limited.

Opportunities: Initiatives and training

Greece

- Greek Women in STEM and Greek Girls Code support women through mentorship, workshops, and events.
- Companies like Microsoft, IBM, Cisco, and Vodafone contribute with coding workshops and digital literacy events.
- Non-profits such as STEAM GREECE and foundations like Onassis STEGI integrate arts with technology.

Ireland

- The STEM Education Policy 2017-2026 aims to improve STEM education quality and female participation by 40%.
- Focus on creating a collaborative STEM education ecosystem.
- Commitment to integrating Arts into STEM, though specific practices for STEAM education are still vague.

Italy

- Initiatives like Piano Nazionale Scuola Digitale and The Coding Girls Project inspire girls in STEM through gaming and programming.
- Projects like Starry Night combine math and art to engage students in interdisciplinary learning.
- Universities offer gender equality courses to promote inclusivity in STEM.

Romania

- Women in Tech® Romania empowers women through networking, mentoring, and skill development.
- L'Oréal Romania for Women in Science Endowments Program supports female researchers.
- Women Entrepreneur Program provides financial support and entrepreneurial/digital skills training. Despite progress, societal perceptions and gender stereotypes remain obstacles.

Common themes and trends

Gender Disparities in STEM

- Severe gender disparities exist in STEM fields in Greece, Ireland, Italy, and Romania.
- Initiatives include mentoring, workshops, hackathons, and educational partnerships to promote women's participation.

Integration of Art into STEM (STEAM)

- Joint recognition of the need to integrate Art into STEM.
- Coordinated efforts in Ireland and Italy involve NGOs and cultural foundations.

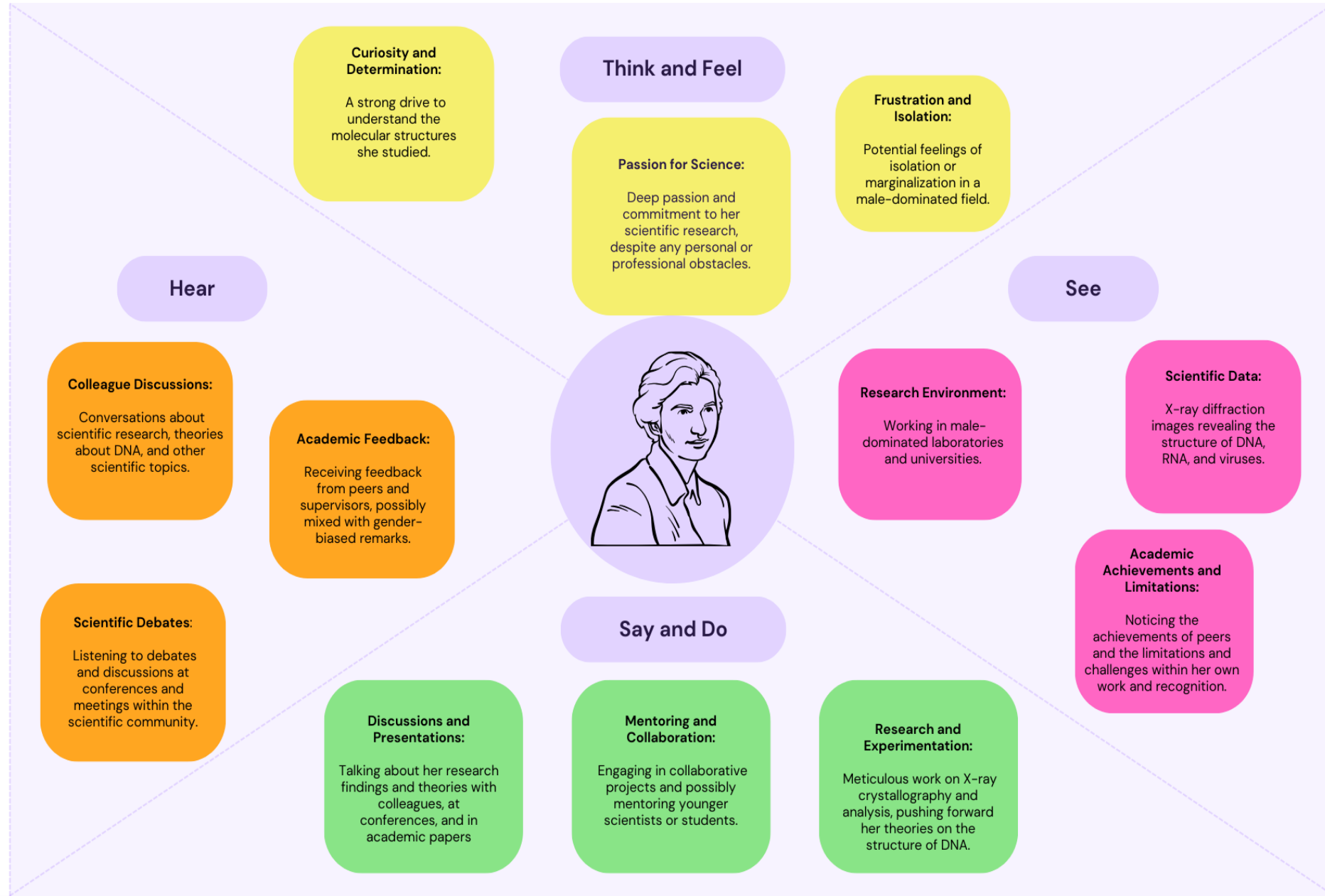
Policy Frameworks for STEM Education and Gender Equality

- Countries are developing policies to enhance STEM education and promote gender equality.
- Ambitious objectives involve various stakeholders but face monitoring and implementation challenges.








Deliverable 1

- Development of educational activities related to 5 STEAM women from the past.
- Creation of empathy maps, guides and additional training for STEAM teachers to address the gender gap.

Rosalind Franklin



Deliverable 2 Adaptation of 5 articles by women in STEAM

<h2>Can Bats give us clues to our own health?</h2> <p>Evolution, Echolocation</p>		<h3>Introduction</h3> <p>Bats have a unique ability to use sound to perceive their environment. This is called echolocation. They emit sound waves from their larynx which reflect off objects in their environment. The bats then hear these echoes, and they turn these echoes into an acoustic image. This enables them to orientate and find food in complete darkness.</p> <p>One of the most unique things that bats do as a mammal is that they fly. In fact, while other mammals can glide, bats are the only mammal capable of true and sustained flight.</p> <p>Economic and Ecological importance of bats. These mammals are pest controllers and pollinators.</p> <p>We can study bats to help us learn about our own health. Scientists have been looking at the unique sensory specialists, the bats, and have analyzed the genes that enable bats and other mammals to see and hear. In bats and other mammals that do not see that well, the scientists have searched for the genetic defects that may break these genes and could lead to blindness. They can then use these data to predict which sites are most likely to cause disease in humans.</p> <p>Bat DNA could contain the secret to everlasting youth. Bats can live up to 9 times longer than expected despite having a high metabolic rate. There are 19 mammal species that live longer than man, and 18 of those are bats. Therefore, they must have something within their DNA that enables them to deal with metabolic stresses of ageing, particularly of flight.</p>	<h3>Methods</h3>    <p>Echolocation</p> <p>Measure the speed of sound with: Two blocks of wood or any items that make a loud, sharp sound when struck together. A stopwatch. A friend to help with the exercise. A tape <u>measure</u>.</p>
			
<h3>Abstract</h3> <p>ONE FIFTH of all mammals in the world are bats so why are they so stigmatized in Western culture? Prof. <u>Teeling</u> believes that these fascinating creatures have a lot to teach us, with their uniquely high metabolic rates and surprisingly long lifespans. Professor <u>Teeling</u> studies mammalian phylogenetics and comparative genomics, with expertise in bat biology and the bat's genetic signatures of survival. Bats, despite using up three times more energy than other similar sized mammals, can live up to nine times longer than expected based on their energy consumption and body size. Generally, smaller animals and animals with a high metabolic rate have a shorter life expectancy than animals with a slower metabolic rate and larger animals like elephants for example.</p>	<h3>KEY TERMS</h3> <p>Evolution, Sound Waves, Echolocation</p>	<h3>Women in STEM - Facts about the author.</h3> <p><u>Emma Carole Teeling</u> (MRIA) is an Irish zoologist, geneticist and genomicist, who specializes in the phylogenetics and genomics of bats. Her work includes understanding of the bat genome and study of how insights from other mammals such as bats might contribute to better understanding and management of ageing and several conditions, including deafness and blindness, in humans.</p>	

Adaptation of articles (cont).

<p>Instructions:</p> <ol style="list-style-type: none"> 1. Find a large empty area such as a field or large court. 2. Choose two spots on opposite ends of the area where each person will stand. 3. Measure the distance between the two spots using a tape measure. Alternatively, you can count off measured steps between the two spots. 4. Have your friend take the blocks and stand at one spot, holding them up high. 5. Take the stopwatch and stand at the other spot. Make sure you have a clear view of the blocks. 6. Signal your friend to bang the two blocks together hard. 7. Start the stopwatch as soon as you see the blocks hit each other. 8. Press stop as soon as you hear the sound from the blocks. 9. Calculate the speed of the sound by dividing the distance between you and your friend by the elapsed time. To get a more accurate measurement, repeat the above steps a few times and then take an average of the results. 	<p>Discussion</p> <p>Bats can see as well as humans can, but they have evolved a sophisticated method of using sound that enables them to navigate and find food in the dark called echolocation.</p> <p>The bats sense their environments and find prey by calling out and listening for echoes made as those sounds bounce off of objects.</p> <p>Bats produce echolocation by emitting high frequency sound pulses through their mouth or nose and listening to the echo.</p> <p>Bats use different inner ear structures to help navigate the world through sound.</p> <ul style="list-style-type: none"> • How to use echolocation for humans' navigation in the dark? • Could we learn from the bats' inner ear anatomy? <div data-bbox="912 746 1243 818"> <p>FUN FACT:The French for bat is chauve-souris – bald mouse!</p> </div> <div data-bbox="912 839 1243 911"> <p>FUN FACT:There are nine species of bat resident in Ireland.They are all insectivorous.</p> </div> <div data-bbox="912 918 1243 989"> <p>FUN FACT:The scientific name for bats is Chiroptera.What does this mean?</p> </div>
<p>Conclusions</p>	<p>Most bats use sound to 'see' the world around them: This nifty navigation system is called echolocation! Bats send out waves of sound from their mouths or noses, which bounce off their surroundings right back to their ears. By listening to the echoes, bats can build up a picture of exactly what's around them – including juicy insects!</p> <p>The scientific name for bats is Chiroptera, which means 'hand wing'.</p> <p>When in flight, bats hearts beat 1,000 times a minute!</p> <p>Bats are hugely important for people and the planet.</p>

Resources:

- <https://www.ucd.ie/scienceforschools/BatsTYBookHighQualitySec1.pdf>
- <https://biologicalsciences.uchicago.edu/news/bat-echolocation-inner-ear-structure>
- <https://science.howstuffworks.com/how-to-measure-sound-travel-air.htm>
- <https://www.ucd.ie/scienceforschools/>
- <http://youtu.be/3BtbS9JC8x8> (great Irish bat clip)
- <http://www.eurobats.org>
- <http://www.csiro.au/Outcomes/Environment/Biodiversity/Spectacled-Flying-Fox/Bat-facts.aspx>
- http://news.nationalgeographic.com/news/2005/01/0127_050127_bats_2.html
- <http://www.csiro.au/Portals/Media/2011/Bat-immunity-key-to-controlling-deadly-viruses.aspx>
- <http://www.batconservationireland.org/>
- <http://www.thewildclassroom.com/bats/videos.html>
- <http://www.arkive.org/daubentons-bat/myotis-daubentonii/video-00.html>
- <http://www.nhm.ac.uk/nature-online/life/mammals/bats/session2/index.html>
- <http://www.rte.ie/radio/mooneygoeswild/factsheets/bat/>
- <http://www.bats.org.uk>
- https://www.ted.com/talks/emma_teeling_the_secret_of_the_bat_genome?language=en

Reflection Questions (in bold the answer for each question)

1. What is echolocation in bats primarily used for?
 - a. Communication
 - b. Navigating through their environment
 - c. Finding food**
 - d. Attracting mates
2. Which part of a bat's body is responsible for producing echolocation calls?
 - a. Eyes
 - b. Wings
 - c. Nose**
 - d. Vocal cords
3. What is the purpose of bat echolocation calls?
 - a. To locate prey**

Lesson plans development 1



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Lesson Plan: Can Bats Give Us Clues to Our Own Health? Exploring Sound Speed

Objective:

- Students will understand the concept of sound speed and how it travels through different mediums.
- Students will learn how to measure the speed of sound using a simple experiment.

Materials:

- Stopwatch or timer
- Ruler or measuring tape
- Small balloons
- String
- Meterstick
- Small pieces of paper
- Small pieces of tape
- Pencils and paper for each student
- Whiteboard and markers



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Introduction (15 minutes):

1. Discussion Starter:

- Begin by discussing with students what they know about sound. Ask questions such as:
 - How does sound travel?
 - Can sound travel through different materials?
- Encourage students to share their thoughts and prior knowledge.

2. Concept Introduction:

- Introduce the concept of sound speed. Explain that sound travels at different speeds through different materials.
- Share real-world examples where understanding sound speed is important, such as in communication systems, musical instruments, and medical applications.
- Explain bats' echolocation and how they use sound waves to navigate and find food, linking this to the concept of sound speed.

Activity: Measuring Sound Speed (30 minutes):

1. Group Formation:

- Divide the students into small groups.

2. Materials Distribution:



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Lesson plan development 2



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- Provide each group with a balloon, string, ruler, small pieces of paper, and tape.

3. Pendulum Setup:

- Instruct each group to tie a balloon to the end of a piece of string, creating a simple pendulum.
- Have the students use the ruler to measure the length of the string and record this length in their notebooks.

4. Conducting the Experiment:

- Have the students pop the balloon and record the time it takes for the sound of the balloon pop to travel up and down the string using the stopwatch or timer.
- Instruct students to calculate the speed of sound using the formula: $\text{Speed} = \text{Distance} / \text{Time}$.

5. Data Sharing:

- After completing the experiment, have each group share their findings with the class, noting any differences and discussing potential reasons for these variations.



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Discussion (15 minutes):

1. Class Discussion:

- Lead a discussion on the results of the experiment. Discuss any variations in measurements between groups and reasons for those differences.

2. Key Concepts:

- Emphasize that sound travels at different speeds through different materials, and the experiment focused on air as the medium.
- Introduce the concept that sound travels faster through solids than through gases.

3. Real-World Examples:

- Provide examples of how sound speed knowledge is applied in various fields, such as engineering, medicine (ultrasound), and wildlife studies (echolocation in bats).

Conclusion (10 minutes):

1. Summary:

- Summarize the key points of the lesson: the concept of sound speed and how to measure it.



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- Highlight the importance of understanding sound speed in different contexts.

2. Homework Assignment:

- Assign a simple homework task related to sound speed, such as researching an invention or technology that relies on understanding sound properties.

Assessment:

• Evaluation Criteria:

- Evaluate student understanding through group participation, the accuracy of measurements, and their ability to calculate sound speed.
- Challenge students to explore how sound speed varies in different mediums, such as solids, liquids, and gases, by designing additional experiments.



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Deliverables 3

Blooming Story Book

is an interview scrapbook developed using digital storytelling techniques to present stories of contemporary women working in STEAM fields and will include lesson plans that can be used in any classroom.

Selection of 10 profiles of women in STEAM from different European countries and disciplines and proceed with storytelling development.

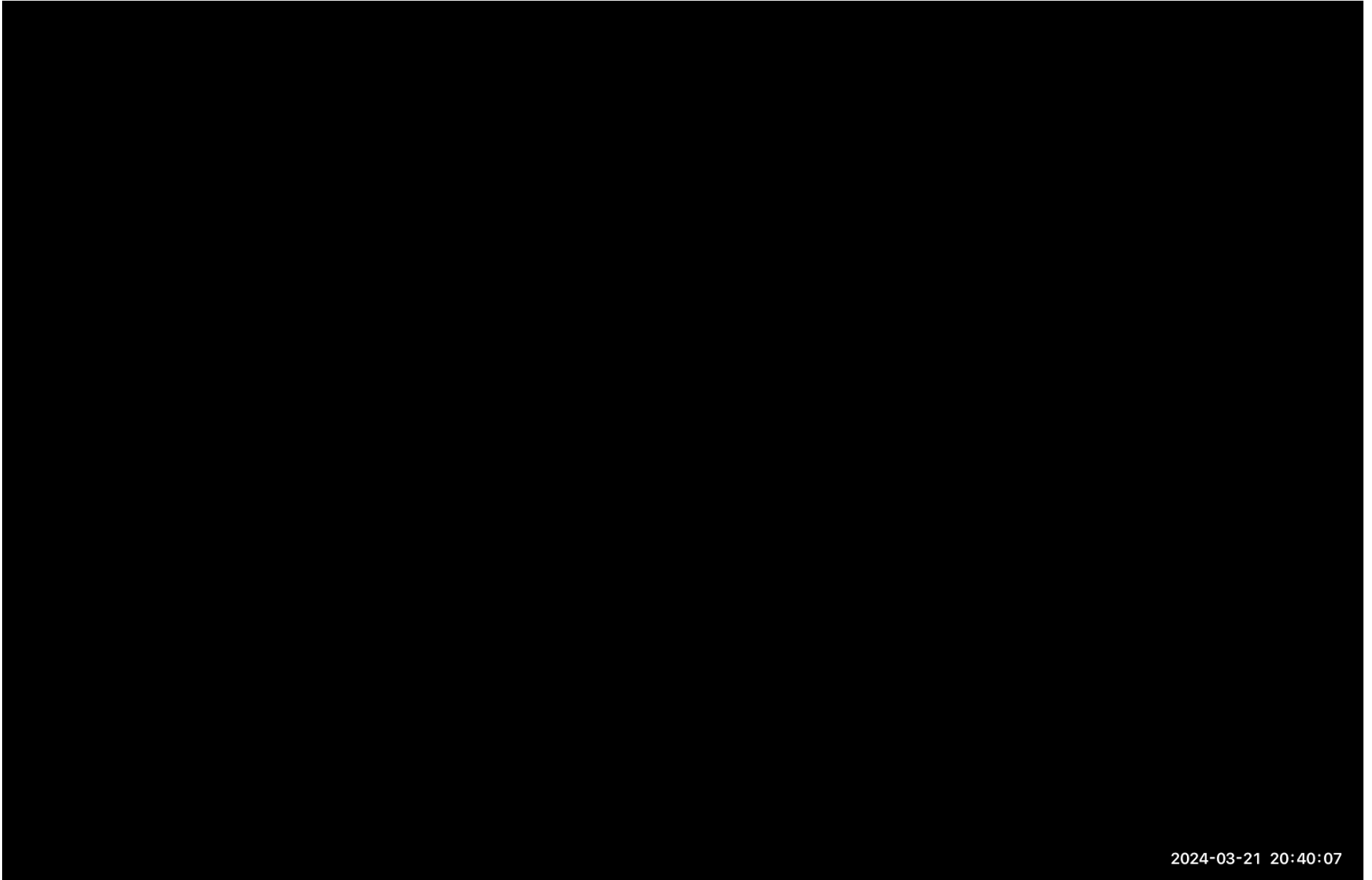
Each partner produces 2 stories for the storybook.

Lesson Plan Development

Lesson plan creation ensuring pedagogical quality.

Creation of guidelines for teachers on how to use the storybook in classrooms.

Short video from the story book



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Testing

Testing and Evaluation

All these activities will be piloted. At least 2 educators from each partner country shall test the stories in their classrooms with students aged 14+.

Gather evaluation data for finalizing the storybook.

Translation and Dissemination

Final storybook translated into partner languages.

Aim to raise awareness about the gender gap in STEAM fields.

Benefits - Outcomes

- This solution is flexible and able to adapt to formal and non-formal education
- Responds to the need for more educational resources to inspire young women to pursue a career in STEAM.
- The use of digital storytelling along with educational materials offers advantages to educators as it makes the learning process more effective.
- It is also an approach that makes the job of teachers easier for this age group in relation to pursuing STEAM careers.
- Students will watch real case scenarios from contemporary society, but will also reflect on and study pioneering women from earlier times.

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Thank you!
Questions?



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