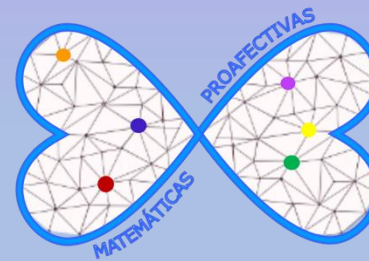


Gender awareness in STEAM education: why and how?



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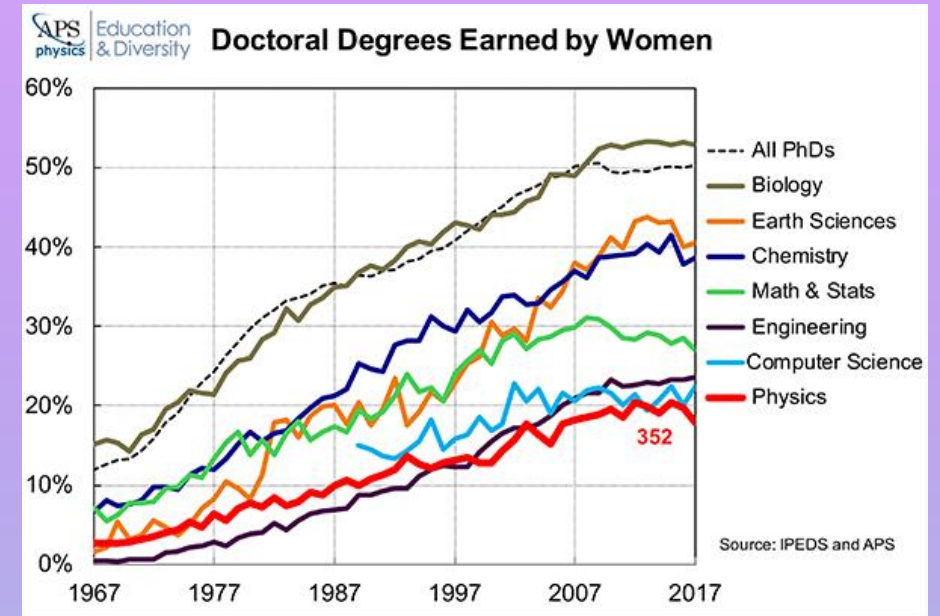
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Is there a STEM gender gap?

Spoiler: yes

- In non-STEM jobs: 49,3%.
- [UNESCO \(2017\)](#): 28% of STEM researchers.
- [MIT \(2023\)](#): 28% of STEM workforce.
- Irregular distribution all around the world, but almost never favours women.
- The gap is bigger in strongly maths based STEM (or hard STEM).

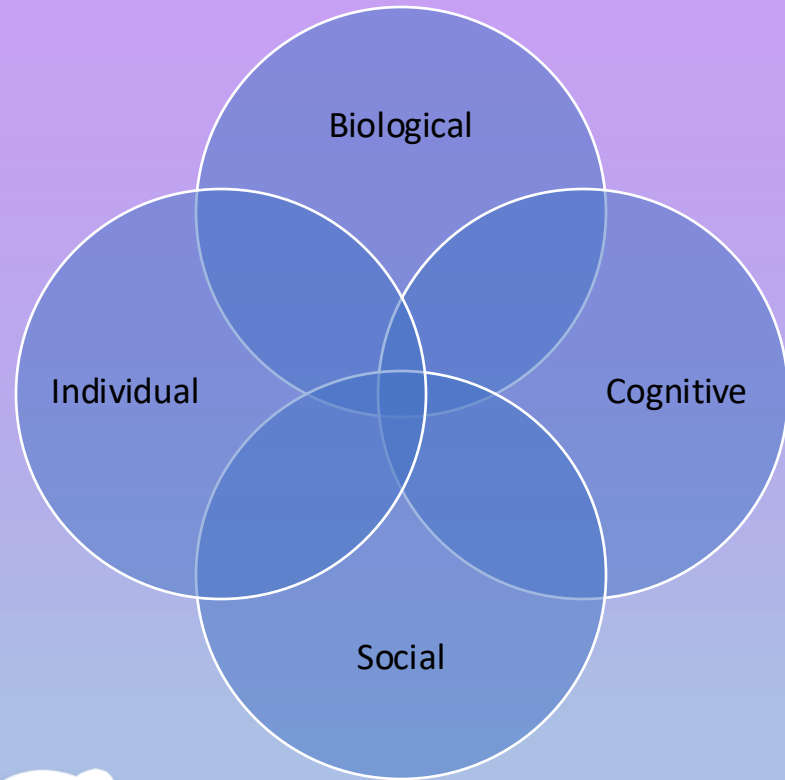
Evolution and closing



- Chemistry: 2087.
- Engineering: 2144.
- Mathematics: 2146.
- Physics: 2158.



Explaining the gender gap



Biological

- Sex - socialization -> Psycho-bio-social approach.

Cognitive

- Mathematics
- Spatial domain

Social

- Stereotypes
- Family and Friends
- School: teachers and biased curricula
- Role models
- Expectatives

Individual

- Affection: attitudes, beliefs and emotions.
- Sense of belonging: STEM identity.
- Expectations and academic success.



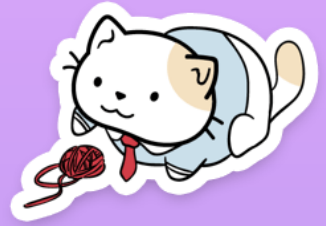
Cognition and affection

Spatial abilities

Mathematics

Interaction between affection and cognition

Spatial domain, maths and STEM

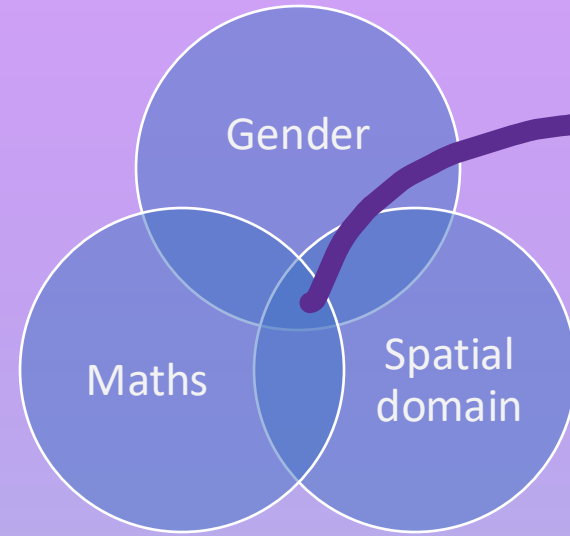


Are boys better at reading maps?

- Yes, from a certain point of view: mental rotation and qualitative orientation.

Good spatial abilities correlate with good STEM performance in general, and with good mathematical performance in particular.

Playing videogames, team sports or building blocks (male games) correlate with enhanced spatial abilities in adolescence and adulthood.



Girls with low spatial abilities are more penalized than boys

We should enhance spatial abilities:

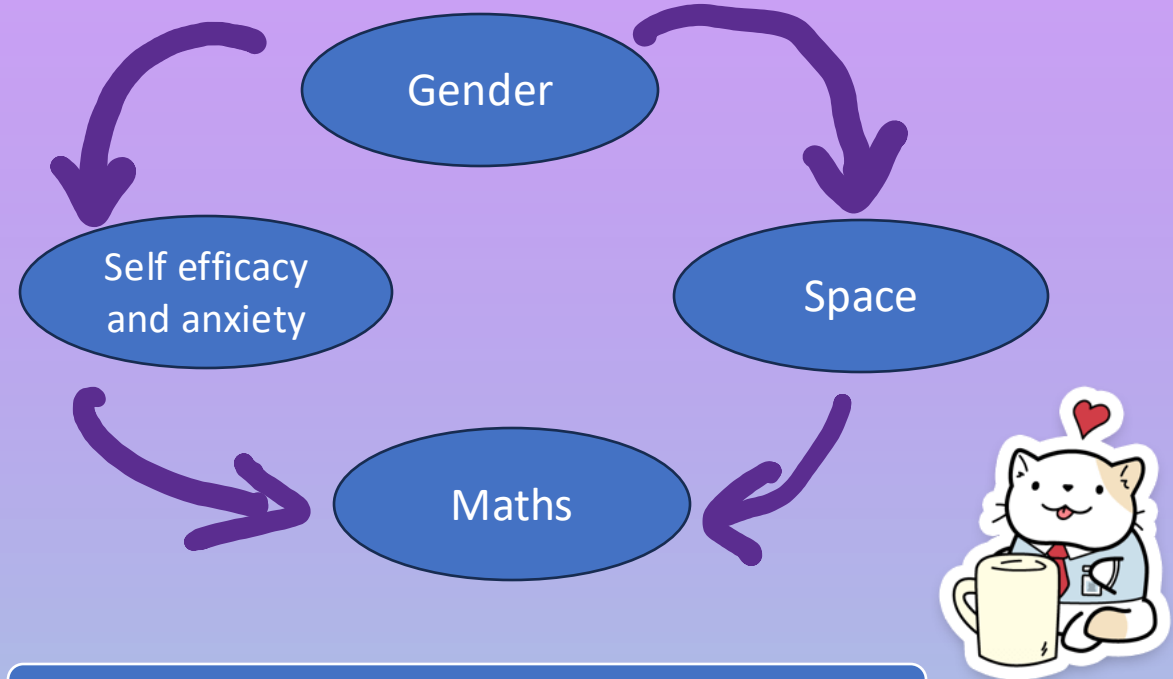
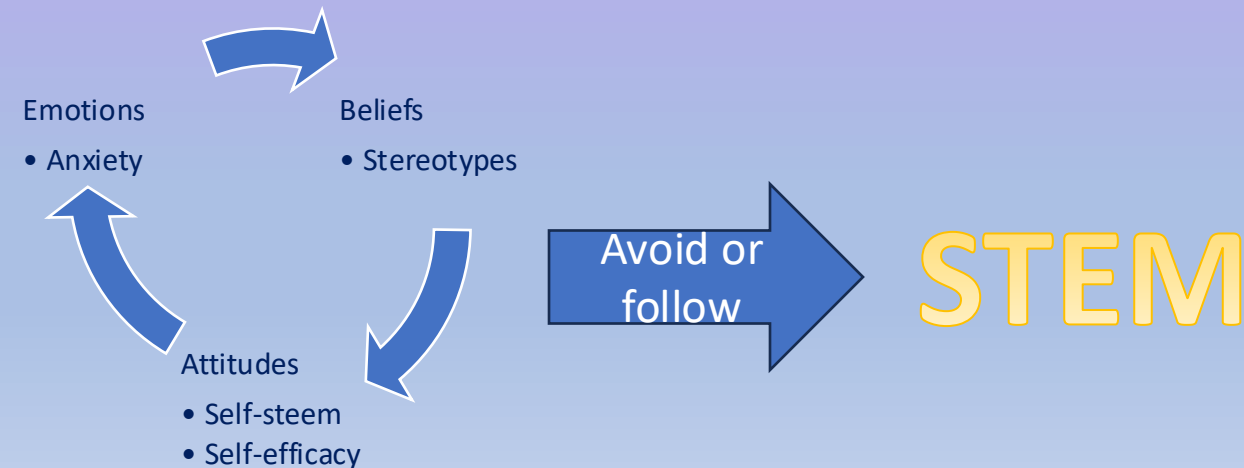
- Specific tasks.
- Unspecific tasks.

Affect, maths and STEM

Myth: maths are for boys

- Inconsistent evidence and variability across countries and gender equality paradox.
- **HOWEVER**, complex problem solving seems to favour boys: they tend to assume more risks than girls, and it seems that spatial reasoning can be a key point.

Affective domain and STEM



We should

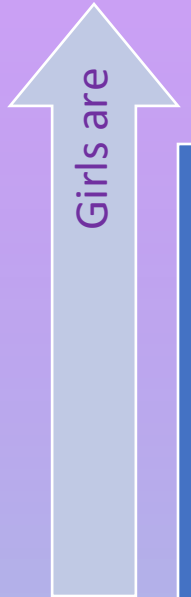
- Enhance spatial abilities (again).
- Metaaffective tasks: writing about feelings, making explicit the stereotype threat, identifying fears

Social factors

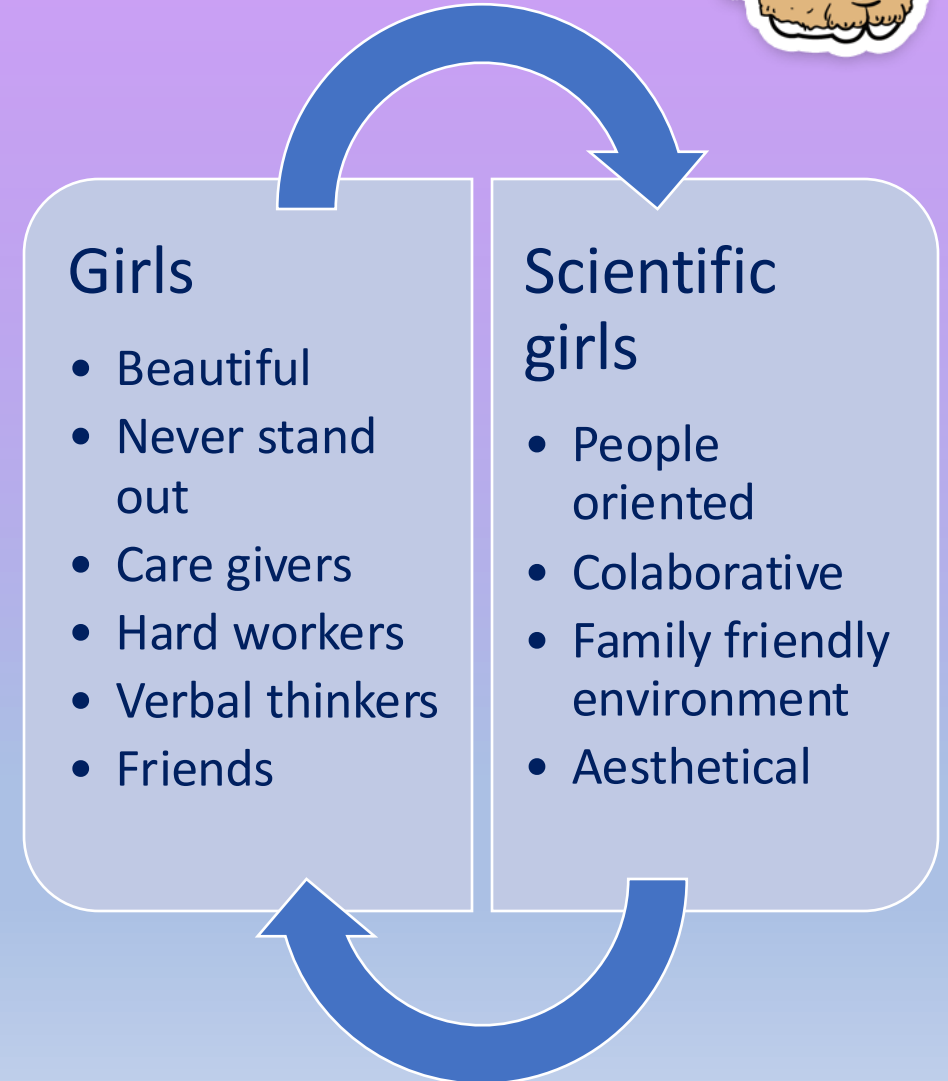
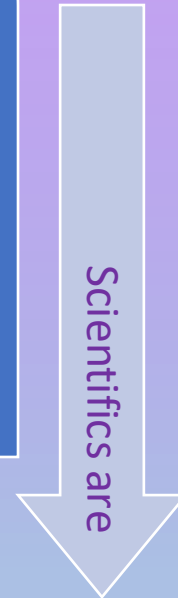
Socialization and stereotypes

STEAM methodology and gender awareness

Socialization and stereotypes



| | |
|-----------------|------------------|
| Beautiful | Careless |
| Never stand out | Weird (nerds) |
| Care givers | Egocentric |
| Hard workers | Brilliant |
| Verbal thinkers | Spatial thinkers |
| Friends | Work alone |



Beware of

- Opinion of family and friends.
- Insecurity and low self-esteem.

We should



Girl friendly lessons

- Collaborative, non competitive.
- Focus on the process (affection).
- Visible and beautiful products.
- People oriented problems.
- Avoid negative stereotypes.

Fighting stereotypes

Positive role models

- Real STEM women with real world problems and preferences.
- Not put too much emphasis in the difficulties but in the achievements.

STEAM methodology and gender awareness

Highlights of STEAM methodology

- Solve real problems.
- Collaborative.
- Multidisciplinary



We should include

Spatial reasoning

Metaafection

Positive role models

**And avoid
stereotypes!**

Examples

An example from primary education: Women, Maths and Mosaics

An example from undergraduate education: MatEsElla (ShelsMath)

Example: Women, Mathematics and Mosaics

Highlights

- 3rd grade students.
- Three main characters that introduce the activities: Hypatia, Emmy Noether and María Wonenburger.
- Play with mirrors.
- Create mosaics and symmetric pictures following Hilda af Klimt and Maruja Mallo.

Results

- Pre-test: the group showed gender bias and stereotypes.
- Implementation: The group experimented with mirrors to explore symmetries and mosaics. They created mosaics and found how to use mirrors to generate them. The activities were introduced by the three mathematician through letters and stories.
- Post-test: the group showed satisfaction and a change in their view of women in science.

Example: Women, Maths and mosaics



Experimental
exploration with
mirrors



Manipulative mosaic
creation



Outcome: mosaics

Example: SteMatEsElla (ShelsMath)

Highlights

- Mentoring programme proposed by Real Sociedad Española de Matemáticas.
- Participants: undergraduate and Master degree female students.
- Mentors: experimented women in STEM jobs.
- Role models and stereotypes through mentoring, coaching and leading training.

Development and results

- Couples mentor-mentoree.
- Specific training for mentors and mentorees.
- Keep free contact for 6 months.
- Conferences every 2 or three months about different subjects.
- Mentors and mentorees find the experience useful and satisfying.

To sum up

Gender gap

- There is a gender gap in some STEM careers.
- Girls and boys don't have the same background.
- The reason is multifactorial.

Close the gender gap

- Close the starting point: freedom of choice.
- STEAM education is suitable to close it.

How do we help?

- Collaborative methodologies.
- Care of affection: focus on the process, metaaffectivity, real world problems.
- Positive role models and breaking negative (and false) stereotypes.



Thank you very much!

