How to include the gender dimension in research (and teaching) in STEM – when it is not "obvious"

Tomas Brage,

Professor of Physics, University of Lund

Member of

The Steering group of LERU PG EDI,

GENERA Network, and

GenderEX Horizon 2020 project

PUSHING THE FRONTIERS OF INNOVATIVE RESEARCH

Disclaimer

- We should use evidence and gender research
- … but here, I will only be able to describe it briefly, to illustrate useful concepts
- … but for full understanding and critical evaluation – go to original work.
- I might be bias towards Physics … but it is valid for all STEM and beyond

"Taxonomy" of Change

Londa Schiebinger, Stanford University

1. Fix the numbers

2. Fix the women

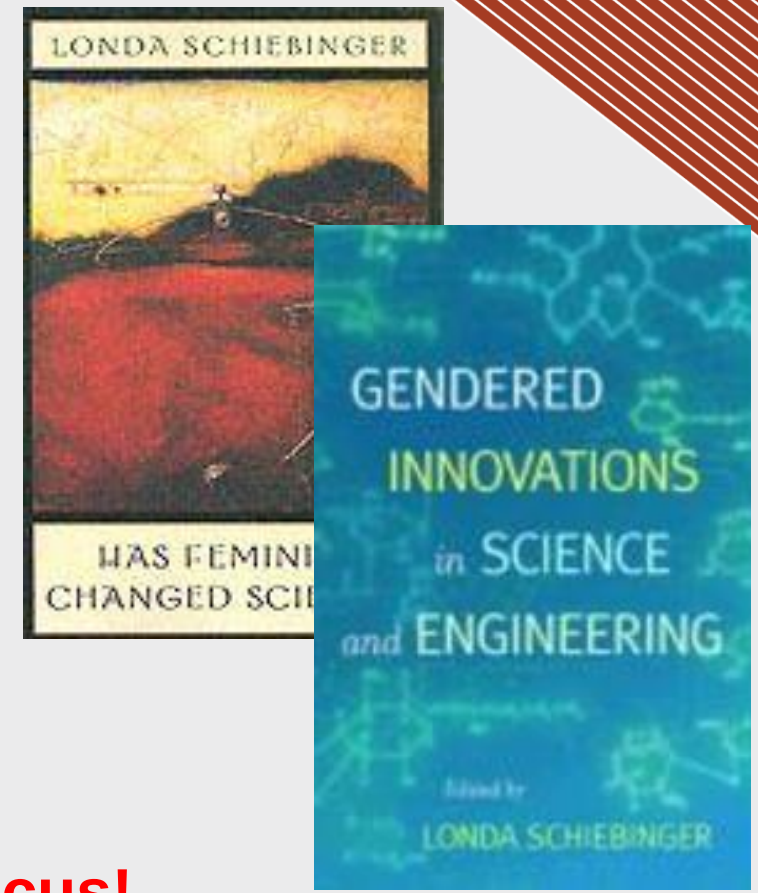
Indicator

Trap!

3. Fix the institutions – Culture

4. Fix the knowledge – Subject

Focus!



Sometimes “obvious” …

- When sex/gender is a characteristics of what you study,
  - e g biology, artificial intelligence, medicine, biophysics …

- or most of applied Science
  – climatology, image processing, engineering, …

… but this is often forgotten

But what about the rest?

Not obvious?

- Where sex and gender is not a part of what is studied,
- or what it is applied to …
- Where there is a strong resistance against a gender perspective
- Where the Positivistic Paradox prevails…
- Example: Math-intensive fields (e.g. Physics)

The Positivistic Paradox in Science:

Science is considered to be objective

– not affected by the sex or gender or … of the people involved (researcher, teacher, student …)

… but ….

Culture of Science is strongly affected by sex, gender, …

- Class-rooms, labs, history, board rooms are almost always dominated by white men

… seems like a **contradiction** …

What we are up against …

The Physicist looks out in the universe and wonders why there is only matter and no antimatter.

Where did the antimatter go?

Is one of the most prestigious questions in Physics and the **subject of thorough research**.

The Physicist looks out over the classroom or lab and notes that it is dominated by men.

Where did the women and minorities go?

Is often a **non-question for Physicist** and sometimes answered **without scientific method**.

Resistance 1: God Trick

- *I study electrons or stars – they don't have a sex!*
- *I study differential equations – their solutions do not depend on gender/sex!*

This is a version of the "God Trick" – we pretend we have a sight or we are situated were we have an objective view. (Harraway)

Resistance 2: Curiosity

- *“I am involved in curiosity-driven Science”*

- But who’s curiosity is driving Science and who decides what and how things should be researched?

Conclusion 1

The only useful definition:

Science is what Scientists do!

.. and we do a lot of gendered things:

- We use metaphors, similes, clichés
- We choose examples
- We name things –machines, labs, particles, equations, properties ….
- We represent science with labels, pictures, …
- We use role models
- **We choose methods, teams, collaborations, what to research**

Using GRI-homepage

Some useful methods from GRI:

- Rethinking research priorities and outcomes
- Rethinking language and visual presentations

The Anecdote of the

Combustion Physics division.

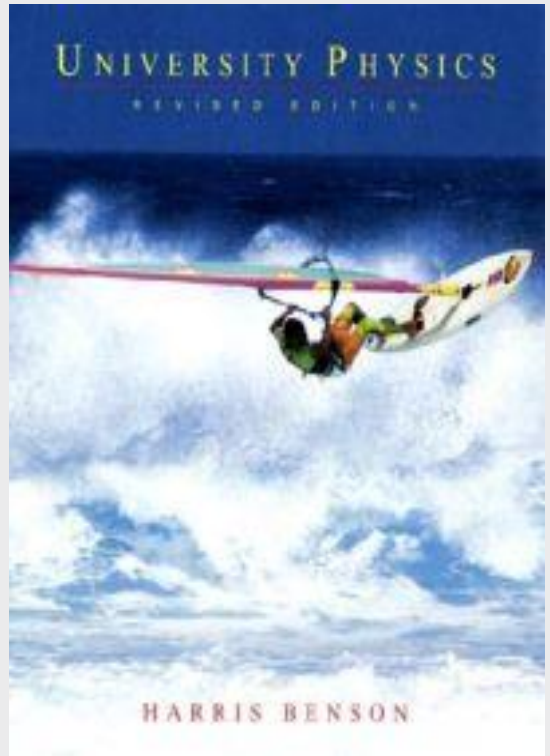
Transformation gave new Science!

Ex: Visual representation

A Standard first year Physics book.

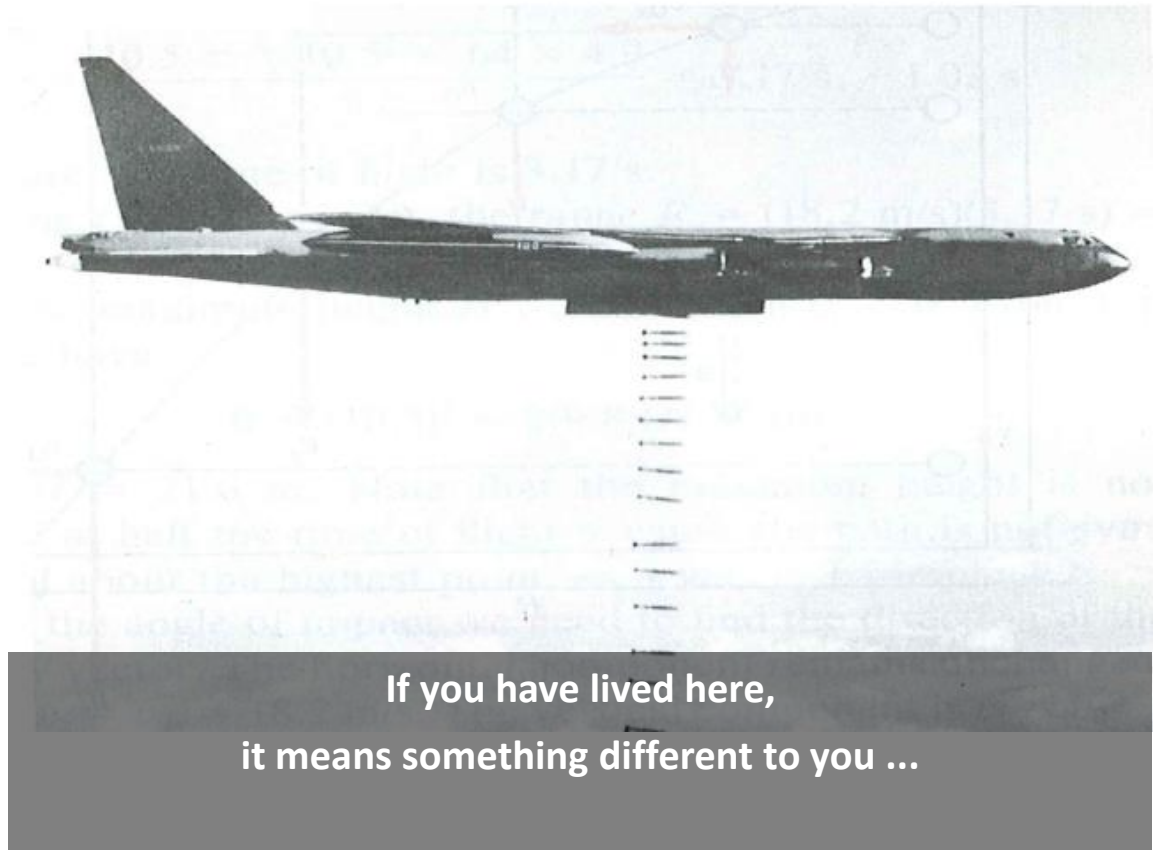
Benson: University Physics.

Reported to be sexist!



Visual representation

We should have been suspicious – first picture:



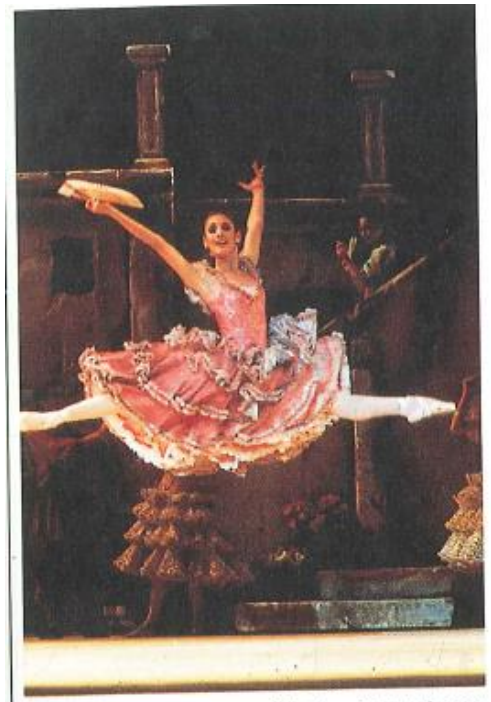
mirrors would produ
the multiple images of
Ann Margaret shown in
Fig. 35.51?

Sexist?

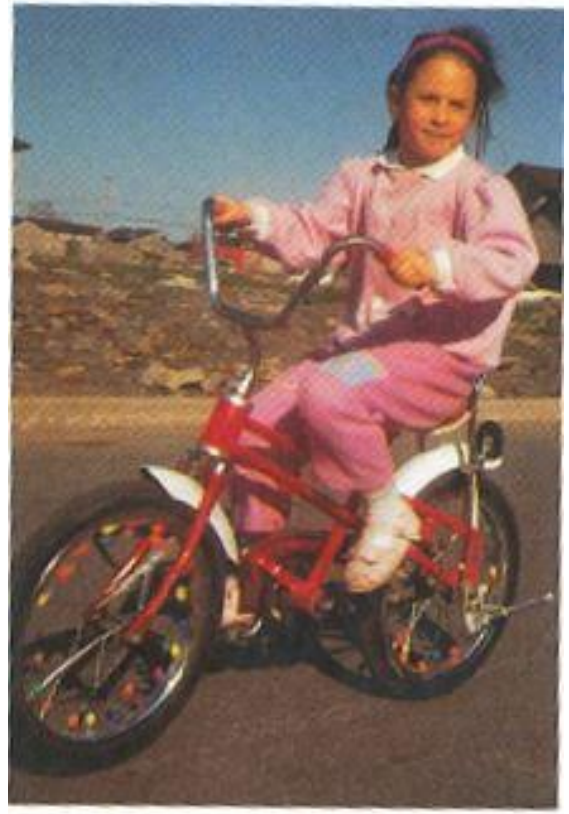
If you have experienced sexual harassment,

It means something different to you

Elizabeth Manley controls her angular speed by varying her moment of inertia.



During a grand jeté, a ballet dancer appears briefly to "float in air". However, the center of mass still follows a parabolic path.

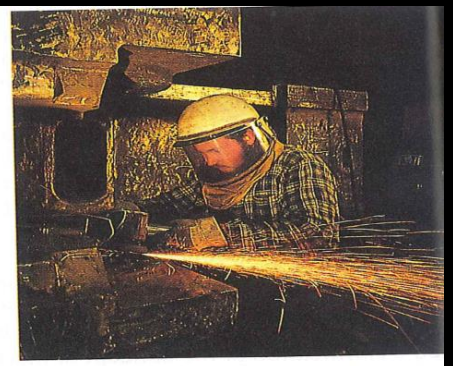


The net work done on the javelin is equal to the change in its kinetic energy.

Pictures of women

Pictures of men

FIGURE 9.1 René Descartes (1596–1650).



(b)

FIGURE 1.8 Johannes Kepler (1571–1630).

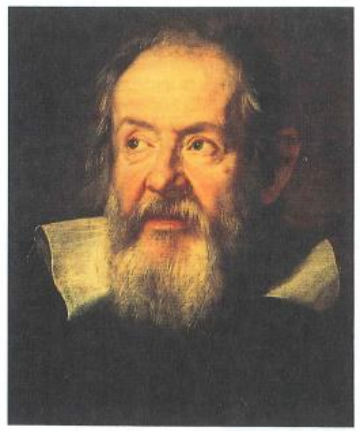


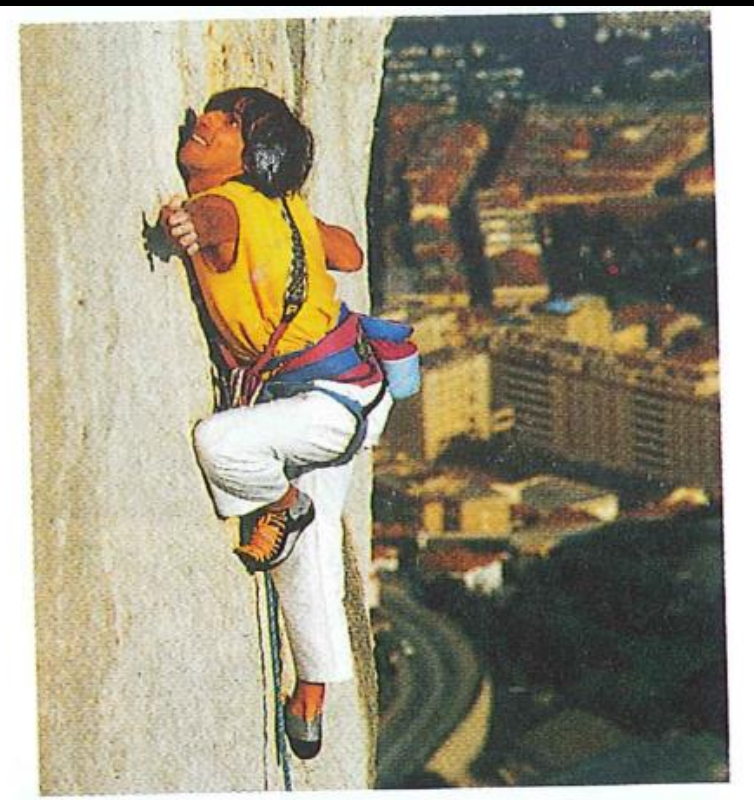
FIGURE 1.9 Galileo Galilei (1564–1642).

FIGURE 5.1 Sir Isaac Newton (1642–1727).

FIGURE 8.2 Gottfried W. Leibniz (1646–1716).

A weightlifter does work to lift weights but not to hold them at rest.

Although the mass of Edwin Aldrin, Jr., had not changed, his weight on the moon was roughly one-sixth his weight on earth.



The climber has done work to increase his potential energy.

Richard Feynman and sexism

That was the beginning, and the idea seemed obvious to me and so elegant that I fell deeply in love with it.

And, like falling in love with a woman, it is only possible if you do not know much about her, so you can not see her faults.

…The message I intended to convey was, nobody thinks of Madame Curie as a woman, as feminine, with beautiful hair, bare breasts, and all that. They only think of the radium part.

(comment on his nude portrait of Marie Curie)

The idea of the bohemian – the rule breaking – brilliant Scientist – goes wrong!

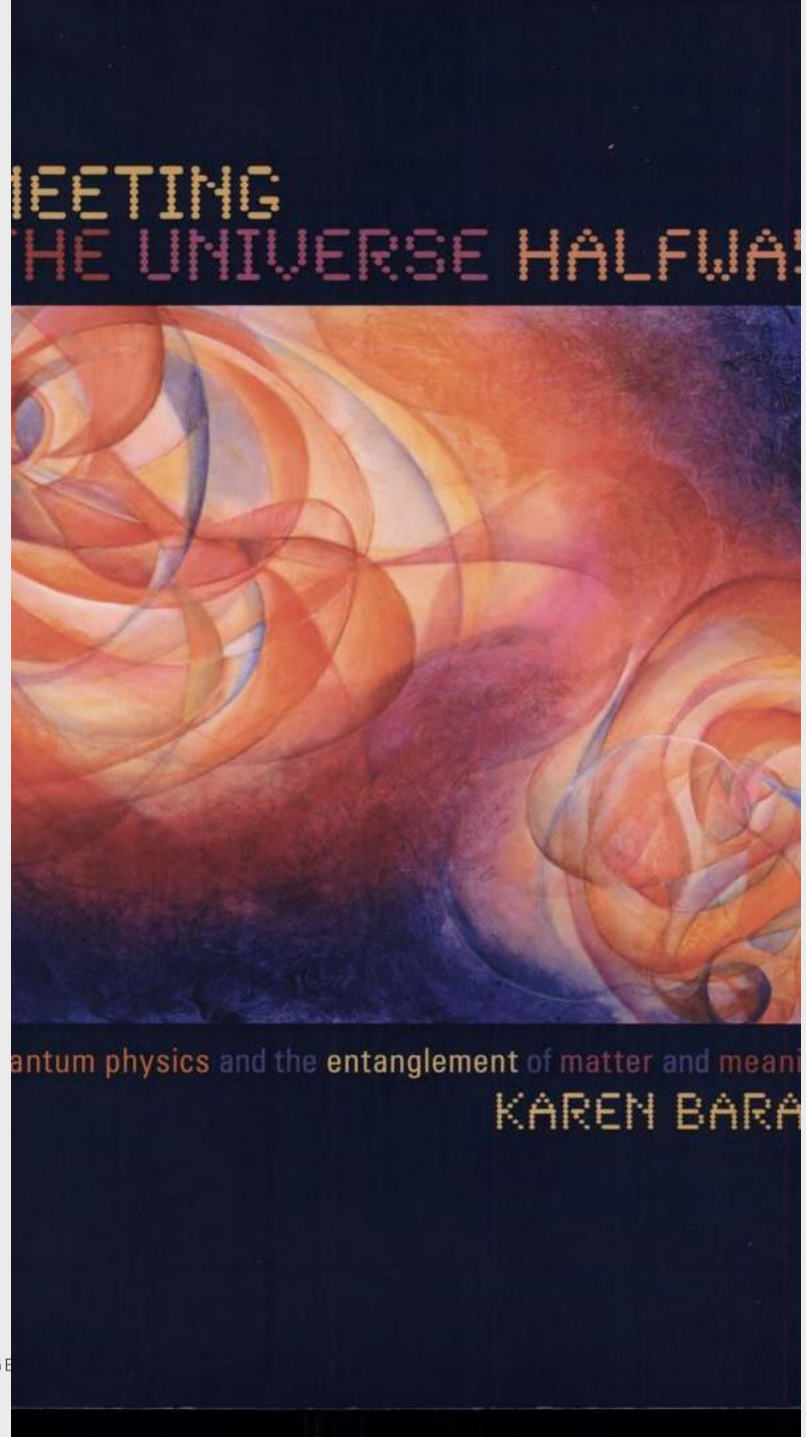
Knowledge production

William Gilbert in 1600's
Magnetism was useful ("compass") and active.
Electricity useless and inactive. Feminine.

Electron (amber stone in Greek) represents tears of women – female morning. Female – water.

When electricity became useful electricity became male – fire.

See Helene Götschel: Plotina-talk: Physics and Gender
https://www.youtube.com/watch?v=U5Yy6LL9FTY&t=2251s



Deeper? Epistemology

Ex: Agential Realism

Newtonian Physics – objective and extremely positivistic

Quantum physics might offer something different:

Entanglement,

Reality-Experiment-Observer

Agential Realism

See Karen Barad, Meeting the Universe Half-way.

Conclusion 2

- Culture and Subject are intertwined – can’t be separated.
- Ex: Culture is breeding certain leaders, who makes priorities that shape Science.
- Culture creates an “image” of Science (and the Scientist), which affects knowledge production.
- To understand the Knowledge production, we need to understand the Culture.

Culture of Physics

- Myths in Physics that affect knowledge production:
  - Culture without culture (Beamtimes & Lifetimes)
  - Priesthood (Pythagoras' trousers)
  - Hercules culture (UPGEM project)
  - Myth of effortless success (Physics Education and Gender)

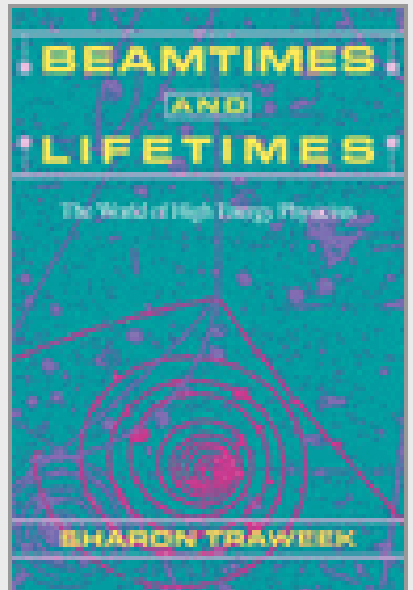
Culture without Culture

Antropological study of Physics labs (SLAC and KEK)

- Culture without culture – “longing” for objectivity
- What is excellent is perceived as male – universally
- Relationship to machines and nature (gendered)
- Grooming of new generations

… Later research: The stronger the myth of objectivity
- the more subjective we get …

Traweek:
Beamtimes and Lifetimes



So what direction is it?

Belief that objective knowledge influences culture

But it is not true – even risk of more subjective culture

And how about subjective culture influences knowledge.

Hercules

Hasse and Trentemöller 2008

Trying to explain different percentage of women among Physics professors in five countries:

Denmark, Estonia, Finland, Italy, Poland

Which one do you think had the highest %?

… and the lowest?

UPGEM
Understanding Puzzles in the Gendered European Map

Hercules

Results (women among Physics Profs):

- Denmark – 3%
- Estonia – 11%
- Finland – 12%
- Poland – 14%
- Italy – 23%

Why? Many thoughts on outside Academia – but no complete correlation (e.g. work-life balance, Classically schooled Physicist, Religion)

– but a new dimension turned up - Culture within Physics!

Cultures within Physics

Hercules:

Oh yes, there is a lot of competition. This whole process is extremely competitive. The case that the department needs to make to the university is that I am not only good enough for the job, but I am the best person in the world for this job.

Care-taker:

There's always a team behind a genius. (...) Good teamwork always brings the best results, but of course, not everyone is lucky enough to find a good group to work with. Sometimes when there are very competitive people, it is difficult to form a group..

Working bee:

But in this respect, for us not to show ourselves too much and do no crazy things, we had to sit quiet and pretend we were not there

Hercules

Denmark – 3% - Hercules

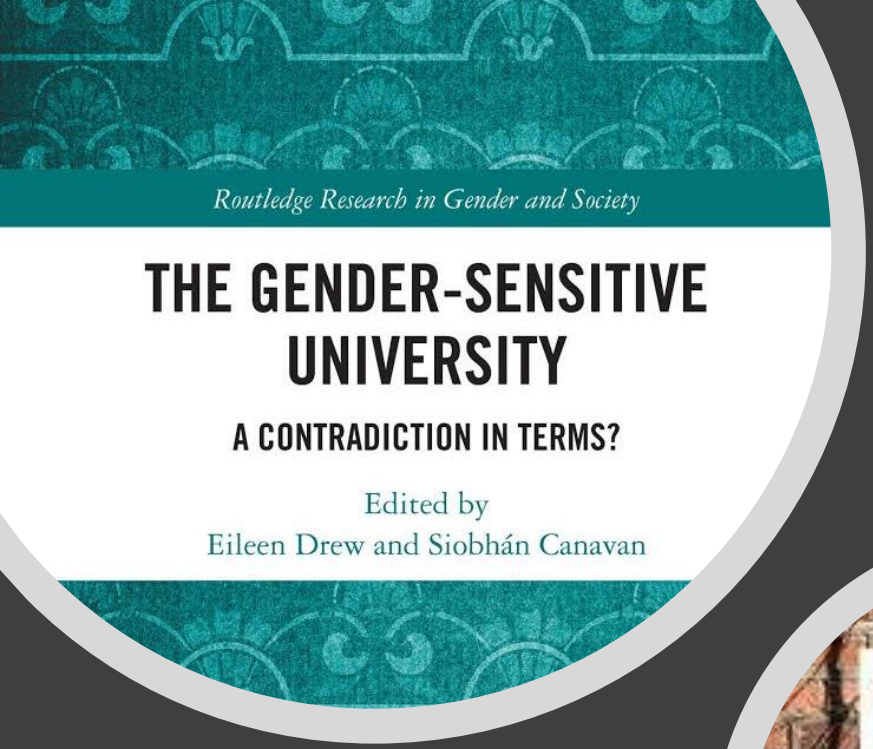
Estonia – 11% - Working bee

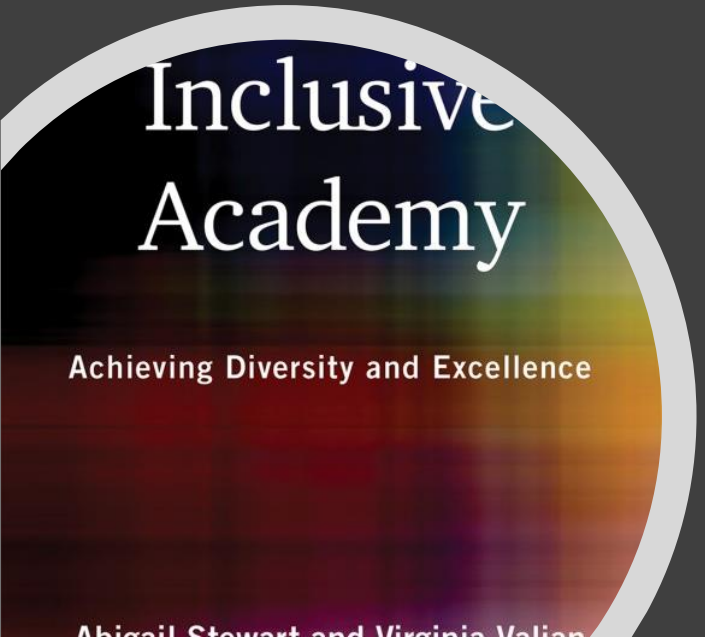
Poland – 14% - Working bee

Italy – 23% - Care-taker

Finland –12% - not a clear culture

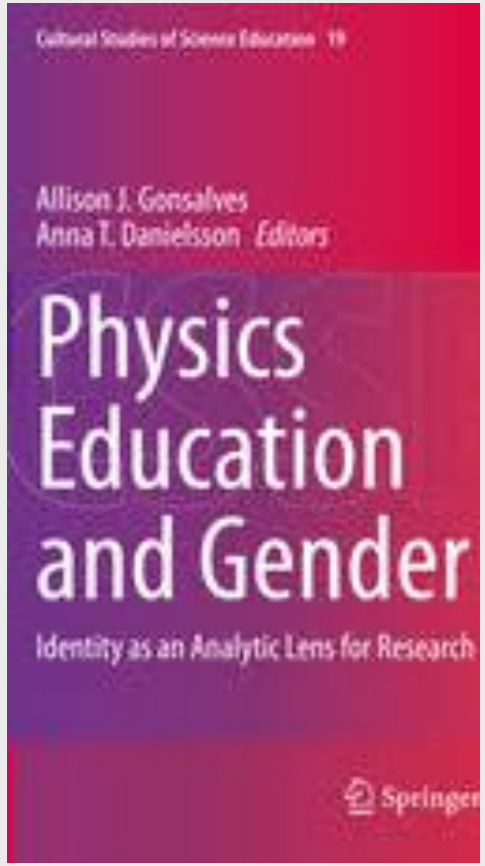
But perception of culture! What does it do to the minorities, how does it affect ”feeling of non-belonging”?





More about these topics

- *Stewart and Valian 2018, Inclusive Academy*
- *Drew and Caravan 2021, Gender-Sensitive …*
- *Brage and Lövkrona 2016, Core values …*



Myth of effort-less success

Boys and girls in school are equally

- Equally interested in method of Physics
- But in different applications

A recognized myth is

- *Successful Scientists are doing Science effortlessly.*

But correct and inclusive idea is “it is hard work”.

Effort-less comes from background, familiarity of examples, metaphors, culture, family background.

Gonsalves and Danielsson 2020

Why?

Diversity gives diverse perspective and more “excellence

- if correctly managed!.

R. B. Freeman and W. Huang, Nature News **513**, 305 (2014):

Collaboration: Strength in diversity

M. W. Nielsen et al., Nature, human behaviour **2** 726

Making gender diversity work for scientific discovery and innovation

K. Powell, Nature **558**, 19 (2018):

These labs are remarkably diverse – here´s why they’re winning in science.

Toolbox from LERU

- Just one of many Advice and Position papers.

Conference “in” Lund

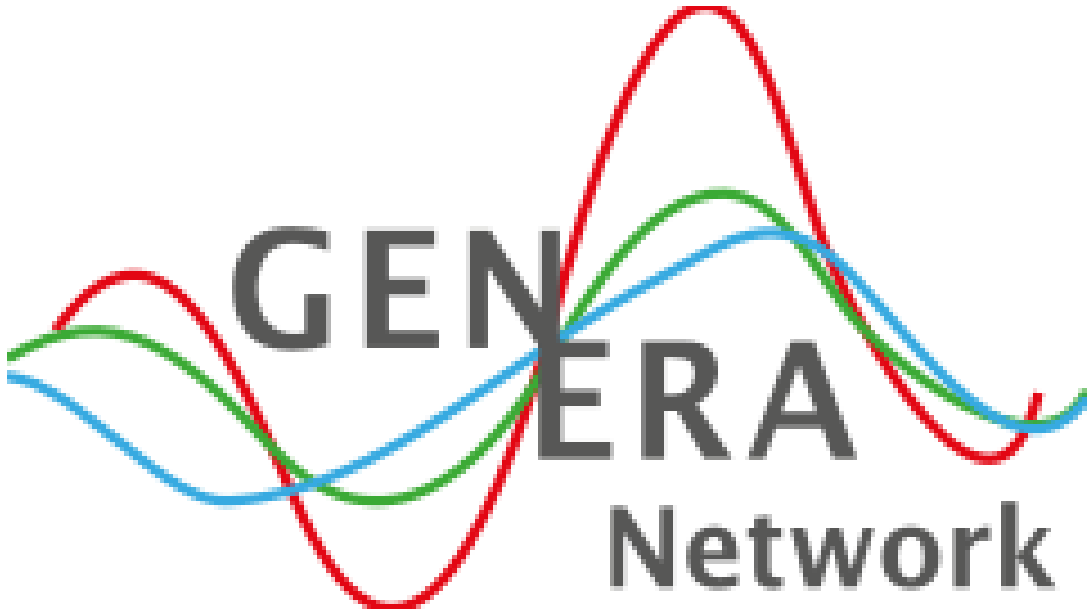
October 21-22, 2021, if possible in IRL (otherwise post-poned)

GENERA conference on

“Gender Dimensions in Physics and other Math-intensive Research and Teaching”

About new ways to approach Gender persectives on these fields. More information on home page of

www.genera-network.eu



Summary – from you

- **Science is not as objective as we ofthen thought**
- **Academic culture could put or not putting Hercules on the pedestal**
- **Success is never effortless – or there have to be a trick**
- **Tell how hard it is going to be!**
- **Culture of Science and dedication to objectivity affects everything**
- **We need life-long learning**
- **Multi-cultural teams and collaboration**
- **Manage your groups.**

Summary – from me

- If Science is defined as what we do, we all need a gender perspective.
- What is perceived as objective is probably worse in culture and thereby needs to include a gender perspective even more.
- Culture and Knowledge production are intertwined.
- There is gender studies on all subjects – including the most resistant ones.
- We need a gender perspective on the knowledge-production, to get diversity and then ... Better knowledge-production.

References

- Brage and Lövkrona 2016, *Core values work in academia – with experiences from lund university*, Lund University
- Conell 2014, *Gender – A World View,* Springer Fachmedien, Wiesbaden
- de Vries, Jennifer 2011, *Mentoring for change.* Melbourne, Victoria: Universities Australia Executive Women & the LH Martin Institute for Higher Education, Leadership and Management.
- de Vries, Jennifer 2012, *"The bifocal approach: (Re)positioning women´s programs". In* Strid, Sofia, Husu, L, Gunnarsson, L. *(eds.), GEXcel. Work in progress report, volume X: Proceedings from GEXcel Theme 11-12: Gender paradoxes in academic & scientific organisations.* Örebro University, Sweden.
- Drew and Canavan 2020, *The Gender-Sensitive University,* Routledge
- Duchesne, A 2020, *Bridging the Gap Between Sex and Gender in Neuroscience*, Frontiers in Neuroscience.
- Freeman & Huang 2014, *Collaboration: Strength in diversity,* Nature News **513** 305
- Gonzalves and Danielsson 2020, *Physics Education and Gender: Identity as an Analytic Lens for Research,* Springer.
- Hasse and Trentemöller 2008, *Break the Pattern!,* UPGEM-project report, Tartu University Press
- LERU advice papers on Gender: https://www.leru.org/publications?q=gender
- Nielsen 2015, *Nature* **525** 427
- Nielsen, Bloch Carter & Schiebinger 2018, *Making gender diversity work for scientific discovery and innovation.* Nature, human behaviour. **2** 726-734
- Nielsen et al. 2017, *Opinion: Gender diversity leads to better science,* PNRAS **114** 1740
- Rosser 1995, *Teaching the Majority,* Teacher's college press
- Rosser 2012, *Breaking into the Lab,* New York University Press
- Stewart and Valian 2018, *An Inclusive Academy,* MIT press