

ENG-622
Learning in Science and Engineering:
Gender differences,
Application and research
on teaching and learning in STEM

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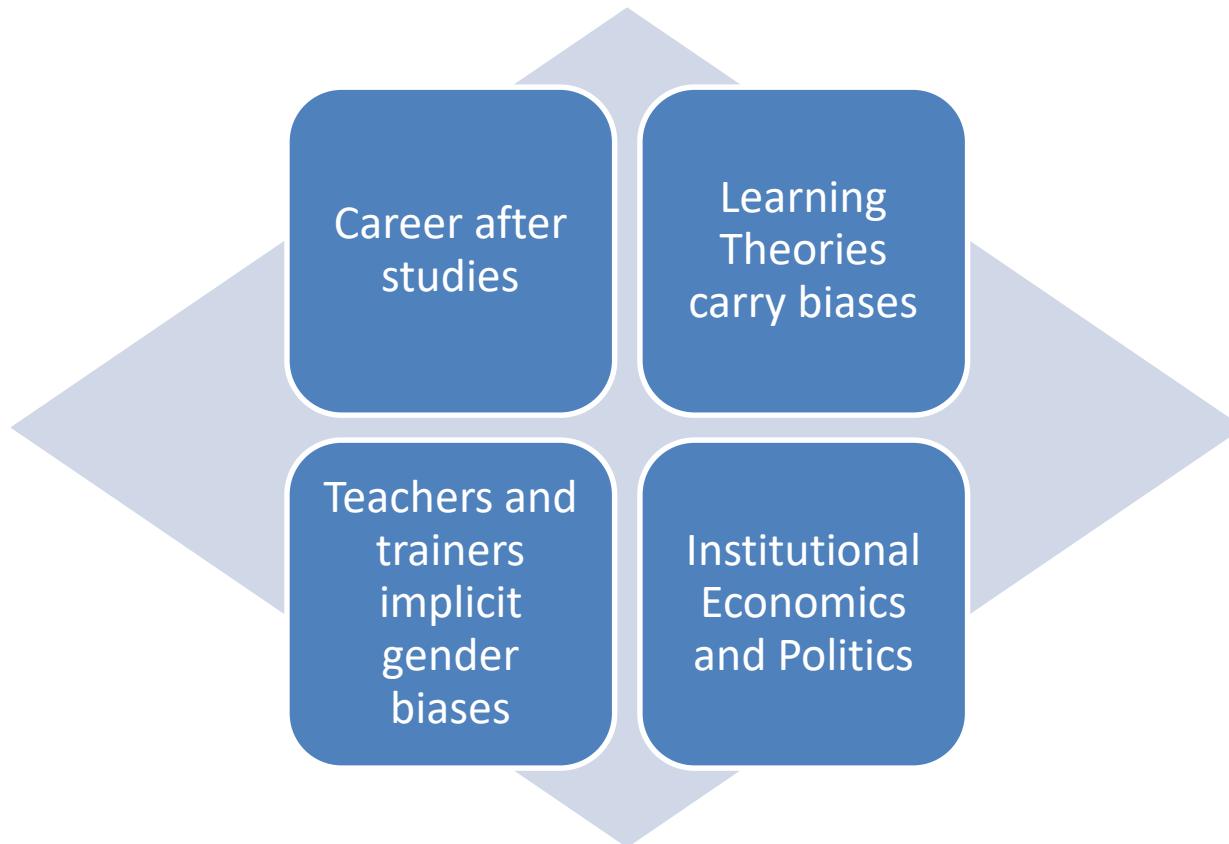
Review of last week

- Communication skills to practice: voice, posture, gestures and eye contact.
- Good presentations have a structure, tell a story and leave a message.
- LOAFS= Lead-in, Objectives, Active information processing, formative assessment and summary

In Science and Engineering,
what can we say about gender
differences?



Approaches to Gender in STEM





Representation of female students in STEM disciplines



Text and image bias –Zittleman and Sadker (2002)



SPOTLIGHTING
The few who dare

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Gender biases favor male students

Moss-Racusin et al (2012): Science faculty's subtle gender biases favor male students

The study: Good (not excellent) application materials of students applying for a lab manager position. Same application, randomly described as John or Jennifer. Reviewed by **127 biology, chemistry and physics professors**

Rated:

- Competence to do the job (John consistently better)
- Hireability (John stronger than Jennifer for identical application)
- Jennifer's consistently offered lower salary and proposed higher involvement in community services –mentoring

Moss Racusin et al (2017) found similar biases in journal reviewers when papers in STEM dealt with gender.



What impact do implicit biases have in STEM?

- Misra et als (2011) studied the choices of female and men professors during tenure: while men do not publish more than women, they are more proactive about research time.
- *'once tenured, women devote more time to teaching, mentoring, and service, and particularly to activities that may be seen as building bridges around the university'.*
- What needs to be rewarded as an educator?

What is left to reflect upon:

- To-be-teachers are exposed to implicit gender biases during their education: they are likely to reproduce them in their teaching (Zittleman & Sadker, 2002).
- Self-selection of women leaving science after completing a PhD may suggest a structural problem in their education.
- Teachers' implicit gender biases can change with training in diversity and inclusion (Jackson, et als, 2014).
- At EPFL we see an increase in female tenure-track assistant professors (30% of PATT and PA) shows that this is a sustainable strategy for equal opportunities (Equal Opportunites Action Plan, 2017).

Intiatives for insipiration

- Mentoring of new female teacher ([Equal Opportunities Office, EPFL](#)).
- Coaching and training through workshops
 - Regards
 - Fix the leaky pipeline
- Controlling Bias in Artificial Intelligence ([Dr. Elisa Celis](#))
- GARCIA project (Gendering the Academy and Research: Combating Career Instability and Assymetries).

Pause



So, we are at the end

What concepts do you recall from the past sessions?

Which concept(s) would you like to try in your teaching?

Take a minute and note down.

It's time to apply!



Aims

- Appreciate the benefits of reflective practice models such as Action Research (A-R) to become a scholar of teaching and learning.
- Talk about your own ideas
- Present the concept list for the exam



Research on Teaching and Learning

NIQUE
iANNE

Aims to improve learning

- Of students
- Of teachers
- Of institutions

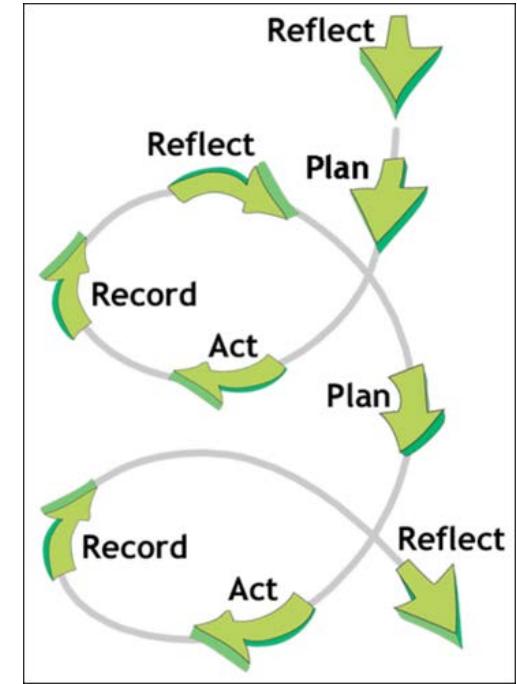


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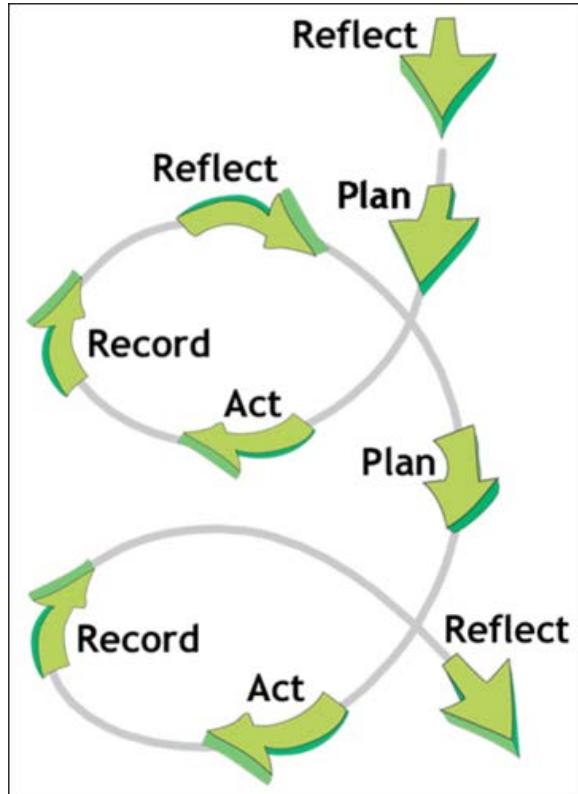
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Action Research

- Is on-going
- Start and ends by reviewing
- Well planned
- Based on evidence and provides new evidence
- Allows to try again or to try what others have tried before



Evidence-informed teaching focuses on



- What works
- What doesn't
- Differences of contexts and of results
- Continuous improvement

Self-monitoring is a highly valued skill for teachers and for students:



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A bit of history ...



NO ACTION WITHOUT RESEARCH, NO RESEARCH WITHOUT ACTION

(Kurt Lewin, 1934)



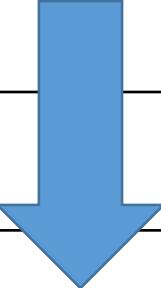


Harwood Manufacturing studies

	GROUP 1	GROUP 2
1	Workers attend a well structured and presented training.	Workers hold weekly meetings to discuss difficulties and share practices.
2	Direct training with opportunities to ask	The group decides on the production goal (75/80/90 units per hour) and makes recommendations to management.
3	Stable productivity Some learning	Higher productivity to first group Learning faster than first group
4	Low morale, slow production	High morale What can change / improve?



Harwood Manufacturing studies



	GROUP 1	GROUP 2
Review	Workers attend a well structured and presented training.	Workers hold weekly meetings to discuss difficulties and share practices.
Plan	Direct training with opportunities to ask	The group decides on the production goal (75/80/90 units per hour) and makes recommendations to management.
Implement	Stable productivity Some learning	Higher productivity to first group Learning faster than first group
Evaluate	Low morale, slow production	High morale What can change / improve?



ACTION RESEARCH IS NOT FOR THE IMPATIENT

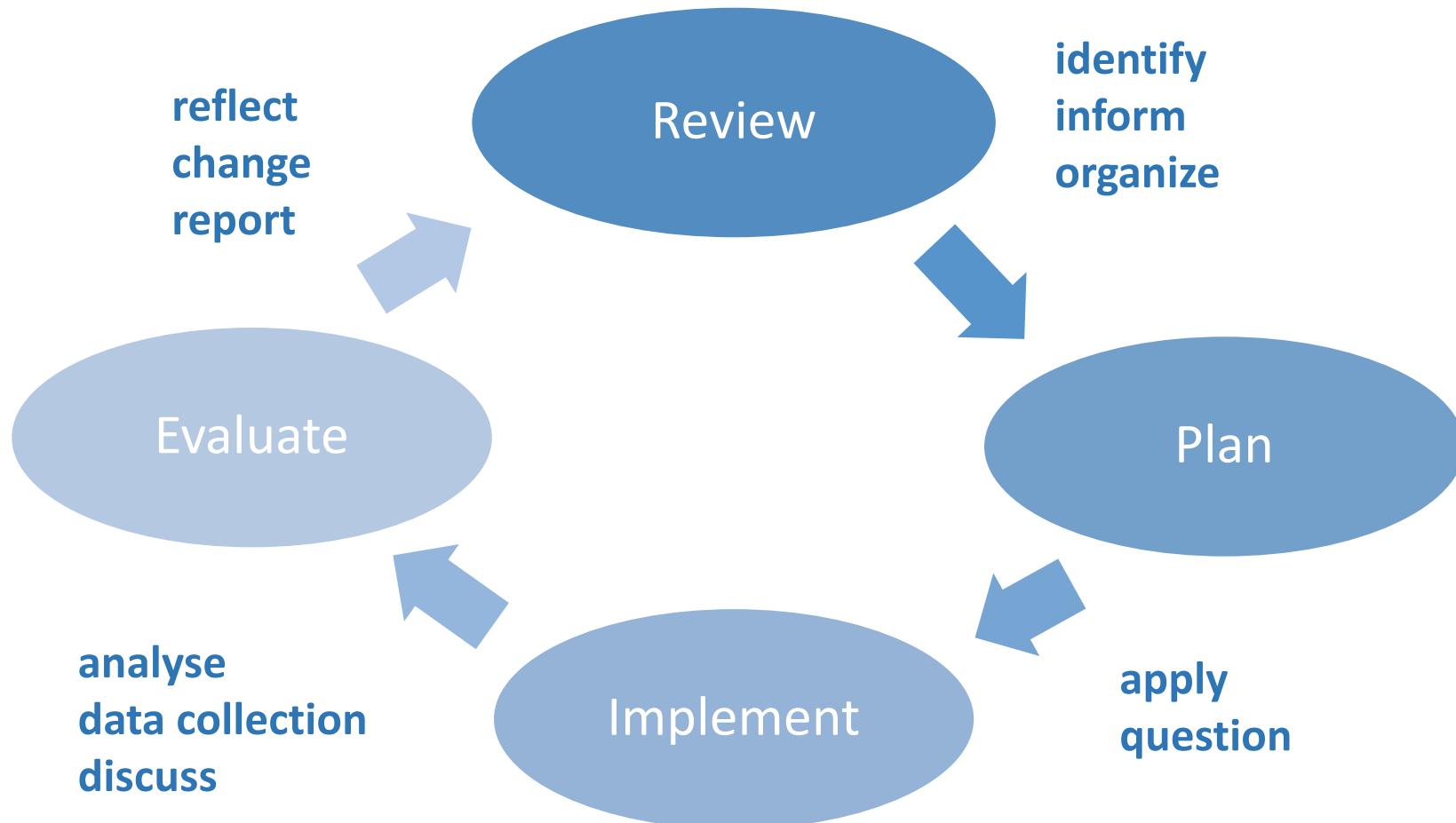
Carl Adelman, 1993
The origins of Action Research



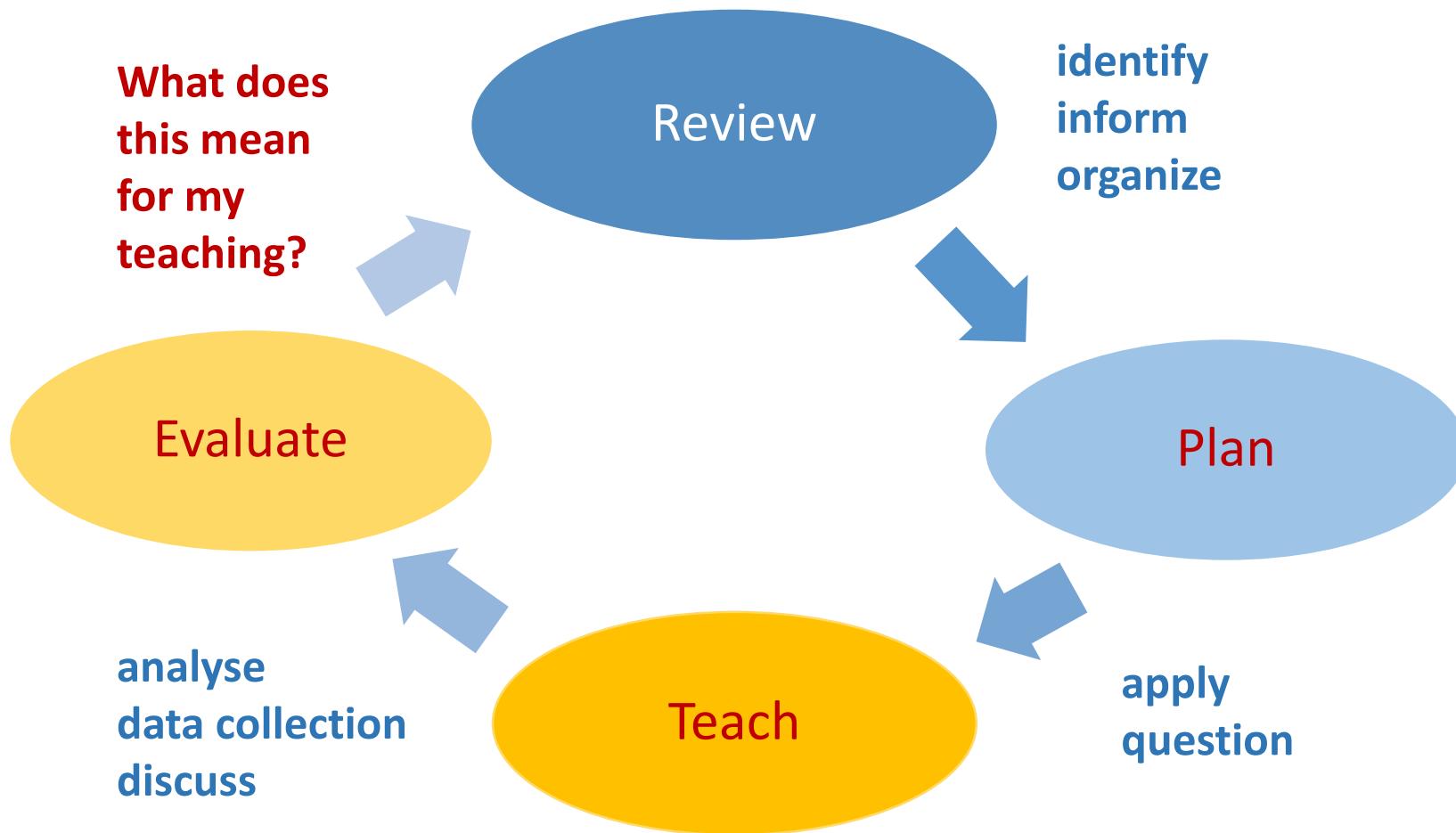
Why is it relevant for teaching?

- Takes learning and teaching out of the experimental situation (laboratory)
- Context is at the heart of the planning
- Accountability and self-monitoring
- Decision making is an informed and consensual action.

ACTION RESEARCH CYCLE



ACTION RESEARCH CYCLE in your teaching



What else?

Learning in Science and Engineering Course Assessment

Session 2018

Oral exam

- December 10, starting 9h30 (30 min questioning per person).
- Pass or fail grade.
- You will explain concepts seen in the course and provide examples of studies done in Science and Engineering teaching and learning.
- Some examples of concepts: scientific misconceptions, feedback, expert vs. novice knowledge, meta-cognition, spaced practice, cognitive load, LTM, intuition, recall, gender inclusion in STEM, self-efficacy.

Written assignment

- 1'000 – 1'500 words
- Structure:
 - Describe one or several concepts
 - Choose a learning scenario from your past experience as an instructor or as a learner
 - Explain the application of the chosen concept in this scenario
 - **Analysis of the potential action that leads to an improvement in learning**
 - Bibliography

Word count

Send it to us by email no later than : 14 JANUARY

- Describe a teaching/ learning situation you would like to improve:
- Define a relevant concept from the course
 - Pick a concept from the course that might help to explain this situation
 - Define the concept using literature
- Apply the concept
 - Identify how the concept applies in your situation?
 - How does it help you explain/ understand the situation?
(Hint: if it doesn't, then pick a different concept that does!!)
- What action/ change does this analysis suggest to you?

Questions?

Oral exam review

Science and Engineering Teaching and Learning 2018, Key concepts

You should aim to be able to describe/define and apply the following key concepts addressed in class and in the literature

1. Learning is work
2. Role of prior knowledge
3. Prior implicit misconceptions
4. Feedback
5. Cognitive load/overflowing brain
6. Spaced practice
7. Metacognition
8. Self-efficacy beliefs
9. Locus of control
10. Distinction between algorithmic and university (complex) problems
11. Schoenfeld's model of necessary and sufficient attributes for problem solving
12. Task, Process and Thinking levels of feedback
13. Cognitive apprenticeship & Disciplinary epistemologies
14. Mastery and Performance Goals
15. Gender biases in STEM education

Sample short answer questions

- Briefly explain what is meant by “Cognitive apprenticeship”
- Briefly describe the benefits of spacing repetitions/ spacing practice sessions for learning. Refer to research evidence in your answer.
- Briefly describe methods used by teacher to clarify students’ conceptual misunderstandings of content. Draw on relevant literature in your answer.

Sample scenario type question

- You are organising a series of exercise sessions as part of a course. Describe what it meant by the concepts of (a) “spaced practice”/“spaced repetition” and (b) feedback and identify how each could be used to improve learning in exercises.

Questions?

Thank you!

We remain available

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Adelman, Clem (2003) *Kurt Lewin and the Origins of Action Research*, *Educational Action Research*, Routledge, ISSN: 0965-0792 (Print) 1747-5074 (Online) Journal homepage: <http://www.tandfonline.com/loi/reac20>

Ford Teaching Project Archive <https://professorjohnelliott.wordpress.com/ford-teaching-project-archive/> University of West Anglia.