

Chalmers STS Working Papers 23-01

# **Gender education at Chalmers: How, when and where?**

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GENIE  
Gender Initiative for Excellence



**CHALMERS**  
UNIVERSITY OF TECHNOLOGY

## **Gender education at Chalmers: How, when and where?**

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Research Report

Chalmers STS Working Papers 23-01

GENIE - Gender Initiative for Excellence

2023-03-08

Front cover Photo by Tima Miroshnichenko (Pexels)

Reference:

Grzelec, Anna (2023). *Gender education at Chalmers: How when and where?* Chalmers STS Working Papers 23-01, Technology Management and Economics, Chalmers University of Technology <https://research.chalmers.se/en/publication/534872>

## Summary

Universities have for a long time tried to integrate gender and equality aspects into the education. In the engineering field, this has been done by including aspects of discrimination, segregation, bias and stereotypes into the education. This has not been easy: For many engineering teachers this is not seen as relevant since those are aspects that belong to the culture of engineering. For some it is not relevant because these are aspects that other professions should work on, for others because they do not believe there is anything to be done about the culture. This project takes a different perspective: Instead of working with stereotypes and bias, this project focuses on the gendered aspects of the subject areas of engineering education. The aim is to connect Gender & Technology studies with engineering education through action research, i.e. by incorporating new knowledge into engineering courses through STEM teachers.

The project identified that since 2009, over 18 EU-projects have been funded focusing on gender equality within STEM fields and/or academia. Most examples of changes to curricula to include diversity or equality questions relate mostly to pedagogical dimensions, or adding awareness of the culture of engineering work. Only a small fraction of the examples of gender inclusion into engineering education involve changes made to the technical/engineering/scientific content of the curricula. The few examples of Gender & Technology research reaching engineering students that were found, were most often materialized through a sort of “add-on” to the education, similarly to Chalmers MTS-credits. This voids the regular education of gender issues, and there is high potential for further integration. Thus, one of the findings of the project is that Gender & Technology research have yet a long way to go to become included in curricula in Europe. Another finding is that gender stereotypes are still reproduced in many of the attempts to integrate gender into the education, and there is still much work to be done to counteract stereotypical gender roles.

### Recommended action points:

- Further development of teachers’ familiarity with Gender & Technology research in their own expertise area.
- Further integration of Gender & Technology research into subject topics in all relevant courses at Chalmers.
- Creation of Communities of Practice (CoP) within the different education areas (EDITI, MATS, KFM, ASAM).
- Investigate the usefulness of a certification scheme for Chalmers’ education.

### Keywords:

gender, gender-sensitive, engineering education, gender mainstreaming, gender & technology

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## Introduction

Gender and diversity are challenges in STEM education. Traditionally this challenge has been addressed by a range of initiatives focussed on recruiting and retaining female and non-majority students. At the same time, there is a research field of gender and technology which has been pursued by historians and social scientists. Historically the link between the two has been weak. At most gender and diversity researchers have been invited to provide guest lectures in technical universities. The course planning has been done by the STEM teaching staff who perceive the challenge but lack the research-based knowledge needed to progress beyond well-intended isolated initiatives. The other side of this problem is that the research conducted by non-STEM researchers has focussed on critiquing the failures of technical universities to effectively address the challenges posed by gender and diversity, leaving a non-constructive trace. This project aims at connecting Gender & Technology studies with engineering education through action research, i.e. by incorporating new knowledge into engineering courses through STEM teachers.

The reason for making such a connection is two-fold. On the one hand professional organizations such as companies that employ engineers strive to employ a diverse work force because it increases their innovative potential. Therefore, they want a more diverse pool to select from. On the other hand it meets current requirements posed on universities in all fields in Sweden (formally, from authorities such as UKÄ and JÄMY). In a society that values equality and where meritocracy is a core value, there is a desire to look into all fields where inequality is perceived. The outnumbering of men in engineering has been associated with a number of negative consequences, including the feeling that women do not belong (Gherardi, 1996; Pietri et al., 2019) and discrimination against women (Moss-Racusin et al., 2012; Heilman & Caleo, 2018). The current state-of-affairs influences the perceived available options when selecting professional career, with girls gravitating to language and boys towards mathematics, independently of prior school results (Cheryan, 2012; Ehrlinger et al., 2018; Wong & Kemp, 2018). This not only has an impact on personal development and perceived viable career options, and thereby individual wellbeing (Stroebe et al., 2011), but it has a larger impact from an ethical point of view: systematically, feminine people (such as women) being excluded from positions of power, economic activity (Marlow & McAdam, 2013; Balachandra et al., 2019), and in making the technology that builds up society (Latour, 1990). These are all factors that highlight the existence of bias and that society currently is not living up to the meritocratic ideals which are aspired to.

Many attempts have been made to attract more women into engineering education (Schiebinger, 2010; Nordvall, forthcoming), some of which have included new organizational practices, such as bias training among staff (Carnes et al., 2012; Jackson et al., 2014), equality policies (Ní Laoire et al. 2021), and inclusive circles of communication (Shah et al., 2020). However, the content of the education has remained more or less constant, feminist pedagogies have not yet become mainstreamed, and technical universities still struggle with male dominance, revealing a slow progress despite efforts to change. It seems that inequality is a “Seven-Headed Dragon” (Van den Brink & Benschop, 2012) while the work to make academy a more equal place “lack

teeth” to fight this dragon. The challenge has also been described as an ontological clash caused by tensions in feminist understanding of engineering work (Udén, 2017).

An example may serve to better understand this ontological clash. Several universities have tried to make STEM educations more attractive to women by catering to the interests and concerns stereotypically enacted by women. One such example is reforming the engineering education to make it more valuable to a wider community and show its relevance from a social perspective: In short, make the programme more socially concerned. While developing the engineering education to involve more components of social and ethical concerns such as environmental and social sustainability is important for all humanity, regardless of gender, we still see a divide in how men and women chose programs: women choose engineering where they can care for others, men choose engineering where they can care for technology.

In Sweden, for instance, adding a program in Media Technologies that functions as a sibling to the traditional Computer Science program has proven successful as it brings in more women into engineering schools. However, such a solution further reifies and sediments traditional gender roles and contributes to the vertical segregation in the profession: women chose Media Technologies and men chose Computer Science. This advances vertical segregation in the engineering profession where women do work that fits with feminine stereotypes, and men do work that fits with masculine stereotypes. The hard wired “tinkering with tech” engineers end up in certain programmes that are male dominated (eg. “Computer Science”), and women who like to work with people end up in programmes with a societal concern (eg. “Media”). This further reifies the gendered stereotype that on the one hand technology is not for women, while social concerns are (Landström, 2007; Vitores & Gil-Juárez, 2016; Gil-Juárez et al., 2018) and on the other hand: Men do not need to care for others or the environment (Pulé & Hultman, 2021). The solutions where two parallel sibling programmes are designed reveal that the university works with the stereotypes, not against them. Instead of providing two different paths, one “feminine” path and one “masculine” path, we need to stir up the gendered nature of the education and include awareness about gender and stereotypes in all educations, and provide students with tools to combat out taken-for-granted assumptions about technology and people.

Another similar approach many education institutions try to attract more women, is to design the education towards feminine learning styles. One example is to build problem-based learning activities, where students have to combine insights from different fields and solve close-to-real-life problems. This caters to what is believed to be women’s higher sense of higher purpose and social concerns, rather than technical concerns or interests, which further reifies the stereotype that women are more socially concerned than men. Thus many practices in engineering education, when focusing on increasing female representation in the education, actually reinforce gender stereotypes, rather than question them.

In the current study, changing the gendered order in the engineering field is attempted from a different angle: *without reproducing gender stereotypes*. The aim is to find ways to make Gender & Technology research (revealing for instance the gendered or discriminatory consequences of technology) incorporated into the engineering education. This is done by searching for examples of how other universities work with gender-sensitive education,

analysing those examples with current gender research, and designing a way that Chalmers can work with including gender into the education without reproducing gender stereotypes.

The project consists of three parts, and the report is structured according to these three.

**1: An inventory of successes and failures with long-term integration of gender and diversity aspects in undergraduate engineering programmes in Sweden and internationally.** Many technical universities have tried different approaches to this issue, and we should learn from them. What are the strategies of these institutions? What are the outcomes of their efforts?

**2: Support GRULG in the continued work with a plan for gender education at Chalmers.** This involved supporting the implementation of gender teaching in various programmes at Chalmers and connecting teaching staff with relevant research on gender and technology and engineering.

**3: A review of current research with relevance for the work going on at Chalmers in order to envision a research agenda eligible for competitive grants.** The emphasis in activities one and two is to support the continuation of change already planned at Chalmers, in contrast the third activity focuses on the research side of gender and diversity. On the other hand, this part underpins and feeds into the other two.

The report is structured as follows. First, the method of the project is presented. Then, in chapters 1-3, the research processes and findings of the various parts of the project are presented. The report then lists the project outcomes and ends with recommendations.

## Method

The first part of the project required an extensive and systematic search for examples of gender mainstreaming into engineering (and STEM) education. Several different sources were helpful in this search:

- Times Higher Education World University Rankings
- UKÄ evaluations
- JÄMY
- 19 EU-projects (see appendix A)
- MIT report “The global state-of-the-art in engineering education”<sup>1</sup> from 2018, further investigating how gender is integrated at
  - Olin college (US)
  - Charles Sturt University (AU)

Journals were searched with the following search terms:

- engineering education
- gender in STEM
- gender in engineering

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<sup>1</sup> <https://jwel.mit.edu/assets/document/global-state-art-engineering-education>

- gender in education
- gender in organizational contexts

Interviews with researchers working with gender in engineering education and observations in other universities were made, from the following universities:

- Linköping Tekniska Högskola
- Kungliga Tekniska Högskolan, Stockholm
- Lunds universitet
- Trinity college, Dublin (IE)
- Universitat Politècnica de Catalunya, Barcelona (ES)
- University of A Coruña (ES)
- University of Jyväskylä (FI)
- TU Wien (AT)

For part 1 of the project, the examples identified were read using the diffractive reading method proposed by Haraway (1997) to discover the specificities and differences between them. The texts were then analyzed with a grounded approach (Wolfswinkel et al., 2013) to identify the themes and various approaches to the topic that has been taken by others (Czarniawska, 2014). Coding was done iteratively with the aid of NVivo software, focusing on how others (through text and interviews) defined gender and diversity issues in education and STEM work, and what content others include into the work with increasing equality and diversity in STEM fields. Doing this analysis, it became obvious that much of the work did *not* focus on how subject-related content, i.e. Gender & Technology research, can be integrated into education. Therefore, the search was expanded and redone several times, in order to find a satisfactory number of examples that could bring saturation. The result of this analysis is presented in Chapter 1. The findings from this search also laid the foundation for parts 2 and 3.

In part 2, the examples were synthesised and calibrated into an education package, making sure that the content of the education is comparable to what other universities and researchers deem relevant gender-aspects of engineering education. At the same times, special attention was paid to make sure that the education package fits the needs and conditions at Chalmers. This process is presented in Chapter 2.

While producing parts 1 and 2, the current research field was mapped, and two research applications were made (see *Project effects/output* chapter). In Chapter 3, learnings from working with integration of gender into engineering education are presented, since these, combined with previous research, lay the foundation of future project applications.

## 1 Integration of gender and diversity into education

When searching for gender, equality, diversity, inclusion on websites of other universities, the findings pointed in the direction of different initiatives regarding the learning/teaching situation, i.e. what needs to happen in the university in order to make it a welcoming place for diverse students. Although it is not what is intended by “integration” of gender into education in this project (which focuses on gender aspects of the education content), some of the results are presented here in order to understand where universities place most of their efforts regarding gender and diversity: in activities *around the education*.

In order to understand further what universities do to integrate gender and diversity issues into the education content, the search needed to be expanded beyond looking at what universities present on their websites. Several EU-projects, with universities as partners, have worked with gender equality in STEM fields, in research, and/or academia. Some of these had developed material for course content, revealing what is considered to constitute gender and diversity in engineering. It was found that when talking about education content, what was referred to what needed to be added to the content of engineering education in terms of the social aspects of the production of STEM knowledge and cultural dimension of engineering/STEM work (eg. who makes engineering knowledge, who conducts research, who is seen as an academic, who is seen as an engineer). This is presented in the second part of this section: *Education content – the engineering work situation*.

After this search, there were still very few examples of Gender & Technology research incorporated into the engineering education content. What was identified is that several EU (and other) projects had worked on tools to help STEM researchers to make their research gender-aware, or gender-sensitive. This is presented in the third and last part of this section, together with an attempt at translating what gender-sensitive research means for engineering education content and how Gender & Technology research can be incorporated into the engineering education. Therefore this part is called *gender-sensitive research and education*.

### 1.1 The learning situation

When searching for gender, equality, diversity, inclusion on websites of universities, many examples of how universities try to make diversified students feel welcome were identified. In the following, a few such examples are listed.

#### Safe spaces

Several initiatives supporting the diversified (i.e. students that are seen as “different”, “diverse” or in minority) students create safe spaces where they can meet and support each other. Safe spaces can be for the underrepresented gender, for people of colour, people with different religious beliefs, LGBTQ+, or first-gen students (people that are the first in their family to attend college). This is a targeted initiative, focused on the easing the negative consequences for minoritized/diversified students in a non-inclusive environment. Safe spaces are not necessarily separatists: they may also fill a role to increase interaction between communities. For instance Olin college has a program of exchange between the majority group and various

diversified groups<sup>2</sup>. One example showed a different conception of “safe space”. Mainstream (i.e. non-diversified) who had taken a course on how to work in an inclusive way, could then label their offices as safe spaces for students, meaning that they would take an active role as supporters of diversified students when needed.

### Complaint systems

Several universities front a complaints system where students can leave complaints if they feel injustice has been done to them, or if discrimination is observed. Research has however shown that such systems seldom work to fight inequality. For one, grievance systems often end up blaming the victim rather than the perpetrator (Ahmed, 2021), and it is difficult to connect complaints systems to equality work because they usually treat each instance of discrimination as an isolated event. Discrimination can be subtle, and each biased act may be too small for official complaints – but taken together, many subtle discriminatory acts or normalized exclusions may reveal a highly toxic and unjust environment (Grzelec, forthcoming). Complaints systems have been shown to function as a window-dressing (Dobbin & Kalev 2017, 2018) to give an air of diversity and inclusion work in the organization, but without really contributing to fairness or justness.

### Pedagogical solutions

Group work tends to be divided among team members according to stereotypical gender roles (Pimentel 2017), where women take the project management role or the write up the lab report, while men do the actual hands-on lab experiment. This is consistent with segregation in professional settings as well, women and men end up in different roles which offers different possible career paths, recognition and pay (Kanter, 1979; Cardador, 2017; Sheerin & Linehan, 2018; Grzelec, 2019; Jang et al., 2020). In order to break this reinforcement of stereotypes, group work needs to be designed to challenge students to learn new things, and to not divide group work in the most efficient way. For instance, by not examining group work, but do a separate examination, or making project roles rotate not only within one project but also between projects, throughout the course of the studies.

There are also examples of alternative ways of teaching, for instance question gender stereotypes while teaching angular momentum, or raising gender issues when teaching Newton’s Third Law of Motion in a participatory way (Thege, Schmeck & van Elsacker, 2020).

Several check-lists have been found (see Appendix B) helping teachers to assess pedagogical aspects of their courses.

### Rolemodels and images

Images and representation is an important aspect in pedagogy: making sure that the class room is a space where different people are represented and feel welcome (Thege et al., 2020; see also Appendix B).

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<sup>2</sup> <https://www.olin.edu/about/inclusion-diversity-equity-access-idea-olin>

Many universities try to present women as role models: highlight women alumnae (see Figure 2), outstanding women researchers, or invite successful women as guest speakers. While the use of role models is a way to fight stereotypical images of engineers and natural scientists (Devine et al., 2012), they also carry a few negative consequences. One such is that women in minority positions more often are called into tasks where they are asked to represent their gender: on boards, in photos, in panels etc. This not only takes away time and energy for them to conduct their work but it can also become an easy way for organisations to show that they enact gender equality values without actually doing any equality work (Omanović, 2013), so called window dressing (Dobbin & Kaley, 2017; 2018).

The image shows a screenshot of the Olin College of Engineering website. At the top, there is a navigation bar with the college logo and several menu items: OUR COMMUNITY, ADMISSION & FINANCIAL AID, ACADEMIC LIFE, RESEARCH & IMPACT, and COLLABORATE WITH OLIN. Below this is a breadcrumb trail: HOME > BLOG > CAREER AND GRADUATE STORIES >. The main header of the article reads "ROCKING A CAREER IN ROBOTICS, MIKELL TAYLOR".

On the left side, there is a sidebar with three menu items: THE OLINSIDER, CAREER AND GRADUATE STORIES, and OLIN ADMISSION. Below the main header, there are social media sharing icons for @, Facebook, LinkedIn, Twitter, Google+, and Pinterest. A search bar is also present.

The article title is "ROCKING A CAREER IN ROBOTICS, MIKELL TAYLOR". Below the title is a photo of Allison Basore, a woman with dark hair, smiling. To the right of the photo, the text reads: Allison Basore '20, achellakere, with a link to "Other articles written by Allison". Below the photo, the date "MARCH 29, 2018" is displayed, followed by a quote: "I'm a Robotics Geek from the class of 2006...".

Below the quote is a larger photo of Allison Basore holding a baby. On the right side of the page, there is a "SUBSCRIBE TO OUR FEED" button, a "FOLLOW US!" section with social media icons for Facebook, Twitter, LinkedIn, YouTube, and Instagram, and a "CATEGORIES" section with a list of article categories and their counts.

**CATEGORIES**

- > A Broader World View (50)
- > A Different Path (30)
- > Alumni Speak (151)
- > Alumni Speak; (1)
- > Alumni Speak; Entrepreneurship; (3)
- > Alumni Speak; Entrepreneurship (3)
- > Alumni Speak; Grad School (4)
- > Alumni Speak; Making a Difference; (1)
- > Alumni Speak; Making a Difference; A Broader World View (12)
- > Alumni Speak; Making a Difference; A Broader World View; Scholarships and Fellowships (1)
- > Alumni Speak; Olin Employers (9)
- > Alumni Speak; Olin Employers; (1)
- > Alumni Speak; Olin Employers; Entrepreneurship (1)
- > Alumni Speak; Olin

Figure 1 Role models on the webpage of Olin College (US)

## Pronouns

Several universities support and encourage the practice to explicitly state your preferred pronoun, to highlight that genders are not obvious, and as an act of solidarity to those that transgress the gender binary. It is not a pressure for everyone to out their pronouns, which can be complicated for instance for those in transition states, but an encouragement for those that have nothing at stake to show their support. This is usually done by stating your pronouns immediately after your name, in brackets like this: “Anna Grzelec (she/her)”, followed by a link explaining why pronouns are important.

### Examples

Pride training, Australia

<https://www.pridetraining.org.au/pages/pronoun-page>

Glsen, USA

<https://www.glsen.org/activity/pronouns-guide-glsen>

Ryerson University, Canada

<https://www.torontomu.ca/ryerson-works/articles/workplace-culture/2018/05/why-include-pronouns-in-your-email-signature/>

## Diversity and inclusion policies

Many universities have some kind of policy regarding inclusion, diversity and equality or equity. They are commonly written to be a manifestation of an intention and function as a code of conduct, guiding how people are to behave in order to comply with the equality/equity intention. They are usually not referencing research. Instead they make references to other policies from outside of the university including discrimination laws or requirements from equality authorities. Most often this is developed by some unit working with student safety and work environment (equivalent to Chalmers Equality Coordinator), such as the Office of Inclusion, Diversity, Equity, & Access at Olin College of Engineering, or Harvard Office for Equity, Diversity, Inclusion & Belonging.

The intention of a policy is usually to manifest that the law (or other kinds of requirements) has been understood, and therefore start with the background of the document. Thereafter, the policy describes how the requirements set out are going to be met through listing a series of practices that the university decided to undertake/implement.

Most policies focus on the work environment of the students: how to make everyone feel included and respected. Most, if not all, policies cover aspects of sexual harassment, and that these are not tolerated in the university context. However, very few policies mention anything relating to the content of the education. One policy that moves closer to the education context was identified, from the Architecture school at KTH, in a document entitled “Rules on gender equality and diversity” (see Appendix B) In this policy, recommendations are made to include women architecture references, and women researchers and lecturers. This is an aspect of representation in the education – not content.

The idea of policies is that they direct behaviour in the organization. Therefore, if an organization wants something to change, it seems logical to change the policy. However, policies do not necessarily translate to the intended action: policies may serve as window dressing (Omanović, 2013; Dobbin & Kalev, 2017; 2018) to make it seem to the outside that action is taken, when in fact status quo remains (Meyer & Rowan, 1977). Another challenge with policies is that they are embedded in a context with certain practices and will be interpreted in subjective ways (Cardador, 2017; Pietri et al., 2019; Ní Laoire et al., 2021). A policy with gender equality practices that function well in one context will not necessarily function in other contexts because there may be counteracting practices, so called gender inequality practices (Van den Brink & Benschop, 2012).

### **Examples**

Helsinki:

[https://www.sage-growingequality.eu/web/assets/media/online\\_library/plans/GEAP\\_Helsinki.pdf](https://www.sage-growingequality.eu/web/assets/media/online_library/plans/GEAP_Helsinki.pdf)

KTH:

<https://intra.kth.se/en/styrning/styrdokument/regler/overgripande-styrning-1.536023>

Olin:

<https://www.olin.edu/about/inclusion-diversity-equity-access-idea-olin>

Oxford:

<https://edu.admin.ox.ac.uk/files/equalitypolicy.pdf>

Ryerson:

<https://www.torontomu.ca/ryerson-works/articles/workplace-culture/2018/05/why-include-pronouns-in-your-email-signature/>

Trinity:

[https://www.tcd.ie/equality/policy/Gender\\_Identity\\_Gender\\_Expression\\_Policy\\_2019.pdf](https://www.tcd.ie/equality/policy/Gender_Identity_Gender_Expression_Policy_2019.pdf)

Being inclusive and respectful

Several webpages include instructions on how to be an inclusive and respectful person, with instructions/suggestions on how to show allyship or use an inclusive language.

### **Examples**

Berkeley, USA

<https://cejce.berkeley.edu/geneq/resources/lgbtq-resources/allyship>

Trinity College, Ireland

[https://www.tcd.ie/equality/assets/docs/Gender-neutral\\_Guide.pdf](https://www.tcd.ie/equality/assets/docs/Gender-neutral_Guide.pdf)

The Institute of Technology at Linköping University has developed a gender-sensitive online education for teachers (Vimarlund, 2019). However, the only teachers that are required to take them are course assistants. While the logic of that is that course assistants have the majority of interaction with students, it still leaves the permanent faculty with a gender-blind perspective. Moreover, it shows that gender-related questions are thought to be about interaction in the classroom (the teaching form, such as ways to include diverse students and give different

students the same conditions) – not in the course content. This is confirmed when looking at the content of the course: it covers several course situations that teachers should pay attention to, lists what dimensions to consider when designing exercises and how to counteract master suppression techniques. On the introduction page the dean of the technical faculty states:

Paying attention to gender and equality is about how we look at each other as human beings. All students should be treated in the same way by teachers and other students. And teaching must be structured so that it does not disadvantage students, regardless of gender, sexual orientation, ethnicity, religion or other belief, disability or age. We who train the technology developers and problem solvers of the future must meet our students in a way that makes all students feel welcome.

(Ölvander, Dean at LiTH intro page to the course for course assistants, accessed 2022-10-28).

The course is designed to help course assistants to be inclusive in their classroom practices – but it does not speak about any change to the *content* of the education.

## 1.2 Engineering culture

Many EU-projects and reports have been made to gather knowledge and spread best-practices regarding the content of the education that relates to gender and diversity. This material has been developed by teachers and pedagogical staff in a variety of fields, including engineering but also other natural sciences and STEM areas. The main finding is that when talking about gender-related content in natural sciences, the focus has been to include learning material about the *culture* where engineering “happens” (i.e. the work environment). The culture refers to the rules, traditions, and practices of engineering work, i.e. the characteristics of the work environment where engineering is carried out or produced. Most often this change to the education involves adding elements that raise knowledge about gender stereotypes and how to counteract them in working life. Several exercises where students are trained to understand gendered aspects of the work environment were identified, and below follows some examples.

### STING

The STEM Teacher Training Innovation for Gender Balance Toolkit developed in the STING project (Appendix A) contains 18 exercises/learning modules that help teachers to be more gender-inclusive in their teaching. The target is younger students, from 12 years of age, but some of the exercise can be used in higher education as well, and thorough workshop/exercise descriptions are provided (with schedule down to the number of minutes for different steps, preparations etc). Most of the exercises are about the cultural dimensions of the STEM field, more specifically about gender roles and stereotypes, in society and in the classroom. Here follows an overview of the exercises:

- Introduction: What is gender?,

- Video Message Architect Game
- Implicit Association Test (IAT)
- Who is the scientist?
- Make a collage / Magazines
- Perception Quiz
- STEM Education and Sensitivity to Gender
- Storytelling – a Strategy for Building Conceptual Knowledge and Skills in Primary Science
- Feedback
- Concept – Context
- Tips & Tricks: Improve Your Gender Awareness in the Classroom
- Write a Letter to Yourself

#### SAGE

The “Creating a gender-sensitive institution”- course<sup>3</sup> (online) developed in the SAGE project (Appendix A) includes one module about unconscious bias. It explains how stereotypes guide people in all realms of life, including education. It helps teachers to understand gender-aspects of their education in terms of what happens in the culture and in the classroom. In one of the reports of the project, detailed courses are suggested with syllabus, learning outcomes, suggested lectures and readings (SAGE, n.d.). These courses cover gender inequality in society and stereotypes, for instance “The social construction of masculinities, femininities & gender-based violence”, “Gender, family and work-life balance”, and “Labour sectorization by gender: Horizontal and vertical segregation”.

#### PLOTINA

The EU-project Promoting gender balance and inclusion in research, innovation and training (Appendix A) has developed a series of videos that can be used in teaching gender dimensions in research broadly. The videos are thorough and some of them are up to 45 minutes long, covering many dimensions. Several videos cover the stereotypes in the profession, such as

1. Physics and Gender <https://youtu.be/U5Yy6LL9FTY> (by Professor Helene Götschel)
2. Gender and academic research, a linguistic perspective <https://youtu.be/ufUBOPhJwrM> (by Anastasia Stavridou)
3. Queer pedagogy and gender diversity (why it is important to consider gender in the classroom) <https://youtu.be/kAKcQqiRzYs> (by Hannah Ayres)

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<sup>3</sup> [https://www.tcd.ie/tcge/international-projects/SAGE/creating\\_a\\_gender\\_sensitive\\_institution/index.php](https://www.tcd.ie/tcge/international-projects/SAGE/creating_a_gender_sensitive_institution/index.php)

## Vives Network of Universities

The Vives Network of Universities (Xarxa Vives d'Universitats) is a network of 22 universities in Catalan-speaking areas in Spain. They have developed a series of guides showing how to integrate a gender-dimension in higher education, in a variety of fields, including Industrial Engineering, Computer Science, Electrical Engineering, Multimedia Engineering, Physics, Mathematics, and Architecture. These guides acknowledge that certain fields are void of gender-related issues in the subject-area. In the Physics guide for instance, it is written that some fields will not have a gender dimension relating to the output, such as theoretical physics or pure mathematics. In the guide to Industrial Engineering, when they talk about Calculus, Chemistry, Mechanics, Geometry, Differential Equations, Electromagnetism, Statistics, Materials, Thermodynamics and Fluid Mechanics they write:

Due to the apparent gender neutrality of the contents of these subjects, gender mainstreaming is often limited to introducing female role models, ensuring that the language used is neither sexist nor androcentric and managing the classroom... the statements of exercises and their contextualisation could include gender aspects or avoid perpetuating gender stereotypes.

(Mas de les Valls & Peña, 2022:17).

In subject areas where gender does not matter (where users are not involved) it makes more sense to talk about stereotypes, and gender roles in the work context (i.e. the culture of engineering work).

## Diversity in the Cultures of Physics

The Erasmus+ strategic partnership for Diversity in the Cultures of Physics (Appendix A) developed 7 different lesson plans<sup>4</sup>, especially designed for "Gender and Physics". Thorough lesson descriptions are provided (with schedule down to the number of minutes for different steps, preparations etc). in the following areas:

Lesson Plan 1 – Identifying and Breaking Stereotypes

Lesson Plan 2 – Dis/ Encouragements in Becoming a Physicist

Lesson Plan 3 – Doing and Undoing Bias in Academia

Lesson Plan 4 – Networking against Structural Inequalities

Lesson Plan 5 – Career Stages and their Shifting Challenges

Lesson Plan 6 – Prevailing Interaction Patterns in the Lab

Lesson Plan 7 – Finding Suitable Work Place Cultures

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<sup>4</sup> <https://www.physik.fu-berlin.de/einrichtungen/ag/ag-erlemann/diversity-in-physics/lesson-plans/index.html>

These lessons are employable in any field is because they talk about bias and stereotypes broadly.

### Baltic gender

Baltic Gender (Appendix A) was an EU-project that produced gender-sensitive teaching-material for teachers in the field of marine-biology. However, their definition of gender-sensitive teaching is broad enough to be useful for teaching also in engineering:

“Gender-sensitive teaching is concerned with what is taught, how teaching takes place, and how what is taught is learned, in the context of female and male students, as well as with teaching methods and learning materials that take into account the learning needs of female and male students”

(Thege, Schmeck & van Elsacker, 2020:9).

The report <sup>5</sup> offers many examples of gender-sensitivity in engineering education, mostly relating to stereotypes of researchers or professionals in the STEM field. For instance, they suggest to include history of the subject you are teaching to understand the stereotypes in the field.

### Kungliga tekniska högskolan

The work at KTH (Royal Institute of Technology in Stockholm) to integrate content regarding gender and equality has so far focused on workplace and cultural dimensions solely. They stress the importance to examine students on gender-related content, and include

- basic knowledge about the concept of equality and gender equality,
- understanding that these are both sustainability goals in themselves and instrumental for other sustainability goals,
- teaching how inequality materialize in practice (eg. pay gap, representation in positions of power, distribution of unpaid labour, violence, and representation in technological development), and
- understanding that in order to reach the sustainability goals, changes need to be made.

Besides this, they also work with providing teachers with basic knowledge about gender-sensitive and inclusive pedagogy. Thus, KTH focuses on the cultural aspects of technology production, and on what happens in the classroom. They also have developed a repository<sup>6</sup> where several examples are available for teachers.

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<sup>5</sup> [https://oceanrep.geomar.de/id/eprint/50001/1/BG\\_D4.2\\_Gender-Sensitive%20Teaching.pdf](https://oceanrep.geomar.de/id/eprint/50001/1/BG_D4.2_Gender-Sensitive%20Teaching.pdf)

<sup>6</sup> <https://www.kth.se/om/equality/necessaren-larande-for-jamstalldhet-mangfald-och-lika-villkor/necessaren/necessar-med-redskap-for-jamstalldhet-mangfald-och-lika-villkor-i-utbildning-1.955898>

### 1.3 Gender-sensitive research

Several of the projects developing content-related material for including the gender dimension in STEM education have also had an element of gender-sensitive research. That is, the projects have also developed material teaching researchers to how to conduct gender-sensitive research. The gender dimension in research is:

“According to the European Commission, integrating the gender dimension involves questioning gender norms and stereotypes and investigating both genders’ needs, attitudes and behaviours. It enhances the societal relevance of the knowledge, technologies and innovations produced (European Commission 2014-2020).”

(Korsvik & Rustad, 2018:13)

According to others, it is a question of going “beyond the familiar or normal and question what is invisible or concealed” and to question “the alleged objectivity of STEM subjects – who is made visible in the research field of STEM?” (Thege, Schmeck & van Elsacker, 2020:25). It is thus not about necessarily about researching gender differences, or sex differences, but understanding that innovation and research can and will have different consequences for different groups. This is why this kind of work may inform the creation of gender-sensitive *education*. Moreover, the existence of these projects show that research methodologies and fields are in a transition towards more gender-sensitive methodologies. This will sooner or later have an impact on what research is included in the education since the education is mostly based on research.

In the following, a few examples of work on gender-sensitive research are presented, coming both from projects where education and research were combined (STING, SAGE and PLOTINA), but also from projects developing material to help researchers do gender-sensitive research.

#### STING

The STEM Teacher Training Innovation for Gender Balance Toolkit developed in the STING project (Appendix A) contains 18 exercises/learning modules that help teachers to be more gender-inclusive in their teaching. While most of the exercises are about cultural dimensions of the STEM field, more specifically about gender roles and stereotypes, four exercises focus on the gender aspect of technology:

- Gender and Technology: Am I responsible?
- Stable Table
- MicroBot Technology
- Task Preferences!

## SAGE

The “Creating a gender-sensitive institution”- course<sup>7</sup> (online) developed in the SAGE project (Appendix A) includes one module about the gender-related content of research. It helps academics make gender-sensitive research and understand the gendered dimensions of the technological or innovation output.

## PLOTINA

The EU-project Promoting gender balance and inclusion in research, innovation and training (Appendix A) has developed a series of videos that can be used in teaching gender dimensions. Several videos cover the gendered output of engineering work. Examples include:

1. Neuroscience and gender [https://youtu.be/hr2YnF5BT\\_k](https://youtu.be/hr2YnF5BT_k) (by Professor Cordelia Fine)
2. Gender and Science: scientific facts and fictions of gender (provides examples of gendered assumptions and stereotypes in scientific research processes, and the biased results). <https://youtu.be/EiWgMEeVwa4> (by Dr Elizabeth Ablett)
3. History and Gender (focusing on the history of science) <https://youtu.be/qRmxvoqhTsk> (by Dr Michael Bycroft)
4. Statistics and Gender (about gender statistics, gender indicators and gender sensitive indicators) <https://youtu.be/2-8jFVkiIoU> (by Dr Anne Laure Humbert)
5. Biomedical sciences and gender (how the consideration of sex/gender in biomedical research influences scientific innovations) <https://youtu.be/IXzWZuwZgKE> (by Dr Antonia Sagona)

## Vives Network of Universities

The Vives Network of Universities has produced a series of guides on how to integrate a gender-dimension in higher education. Guides have been made for a wider range of programmes, including Industrial Engineering, Computer Science, Electrical Engineering, Multimedia Engineering, Physics, Mathematics, and Architecture. The guides cover both the cultural dimensions as well as give examples of subject-related gender-sensitive research that can be included in curricula. Below follows an excerpt showing examples that can be included in Industrial engineering at bachelor and master levels:

At the bachelor’s degree level, this block would include subjects such as Machine Theory, Environmental Technology, Thermal Technology, Electric Machinery and Manufacturing Systems. As these subjects are part of bachelor’s degrees, factors relating to the final design of the product are still not very evident and the final user of the product could be relegated to second place. However, environmental and safety aspects are relevant. For example, in Thermal Technology, insulation tends to be designed for thermal components to avoid heat loss to the outside and the risk of burns

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<sup>7</sup>[https://www.tcd.ie/tcgel/international-projects/SAGE/creating\\_a\\_gender\\_sensitive\\_institution/index.php](https://www.tcd.ie/tcgel/international-projects/SAGE/creating_a_gender_sensitive_institution/index.php)

to operators. Therefore, thermal losses can be related to environmental aspects and criteria established by safety regulations can be discussed. This last point is important, as it should be reviewed how safety criteria are obtained, on what type of person they have been based and whether diversity should be considered. The same analysis could be applied in Nuclear Technology with the maximum radiation dosage. A special case is that of the subject Environmental Technology and Sustainability, as the content includes an analysis of the system of life in our society and sustainable consumption alternatives. Therefore, the social relevance of the subject is evident and enables reflection from different perspectives on gender, cultural habits and roles in society.

At the master's degree level, this block of subjects includes Thermal Machinery, Constructions and Industrial Architecture, Technological Innovation and Transport, among others. At this level, the social significance of technology is more evident and should be explained. For example, atmospheric pollution by combustion gases is an unavoidable topic in the subject Thermal Machinery, and preferences when choosing a car or another product could be related to variations in environmental sensitivity due to gender. Another example are contents relating to urbanism in the subject Construction and Industrial Architecture. In these contents, gender aspects are relevant as they relate habits that are currently differentiated by gender with a population's urban development needs (Bondi and Rose, 2003; Fenster, 2005). The same thing occurs in the analysis of passenger transport in the subject Transport. Indeed, it is precisely in the different ways of consuming a product (transport, a component or a source of energy) that we can find behaviour differentiated by gender, nationality or purchasing power, among other factors. The subject Technological Innovation also enables the gender perspective to be incorporated into the phase of identifying new products and their design.

(Mas de les Valls & Peña, 2022: 18-19)

Other examples can be found in the other guides.

#### University of A Coruña

When observing one teacher training session in Spain (given by a teacher from Universitat Politècnica de Catalunya for engineering teachers in University of A Coruña), a few interesting points came up in the dialogue between the teachers (only women).

One point that came up is to ask yourself, as a teachers, what *else* are you teaching? Besides the things you are explicitly teaching in the curriculum, what are you teaching at the same time? Are you teaching stereotypical gender roles for instance? Are you teaching which jobs that are most important?

Another suggestion that came up, which was unique to this sample, was that when teaching subjects without human users, try to add the human into the stage. What happens when this is used? By whom, and how? What the human may be in your highly theoretical (mathematics,

physics or chemistry) course could be trying to contextualize the course in the same way as you would to someone from outside: Start with a sentence that highlights the relevance for society.

## GARCIA

One toolkit that includes both the cultural dimensions of engineering work as well as examples of gender-sensitive research to be included in education was developed in the EU project Garcia: Gendering the Academy and Research: Combating Career Instability and Assymetries (Appendix A). Besides the checklist (Appendix C) there is a report which provides examples of gender-sensitive research that can inspire teachers (Trbovc & Hofman, 2015).

## Linköping Tekniska Högskola

One example was found where a course with gendered perspective was included as compulsory in the curriculum at one university: The Institute of Technology at Linköping University. This course is called “Diversity and Gender in Application Development” (Mångfald och genus inom applikationsutveckling) and is given on the third semester on the Bachelor level in the Civilingenjörs-programmet in Information Technology. This course has four modules about the content, i.e. the (in)equality consequences of application development, and one module about the workplace culture, thus giving more importance to the content. The modules are:

- *Module 1: Intersectionality – Design for whom?* Intersectionality, identity, personas and stereotypes.
- *Module 2: Norm critical/creative design.* Norms and materiality.
- *Module 3: Online hate, dangerous data?* Online/offline hate, technological affordances, social media och democracy.
- *Module 4: Social robots.* Humans, intersectionality, and robots.
- *Module 5: IT as a workplace yesterday, today and tomorrow.* Workplace culture.

This course has two highly relevant course books that very clearly covers bias and inequality produced by data and algorithms, or toxic tech.

- Wachter-Boettcher, Sara (2017) *Technically Wrong. Sexist Apps, Biased Algorithms, and Other Threats of Toxic Tech.* W. W. Norton and Company  
Covers how gender blindness produces bias, and includes chapters on:
  - Algorithmic Inequity
  - Meritocracy Now, Meritocracy Forever
  - Normal People
- D'ignazio, C., & Klein, L. F. (2020). *Data feminism.* MIT press. Open Access <https://data-feminism.mitpress.mit.edu/>  
Covers the subjectivity of data collection and production, with chapters such as:
  - 1. The Power Chapter,
  - 4. “What Gets Counted Counts”
  - 6. The Numbers Don’t Speak for Themselves

The fact that such comprehensive course material exists and is readily available may contribute to the inclusion of such course into the programme: Potentially it may be perceived as less controversial than a similar course in a different engineering topic where such books are not yet produced.

Kilden gender research center.

Kilden gender research center. (part of Research Council of Norway) has produced a report on gender aspects in research, in order to support researchers in including gender dimensions in their research: “What is the gender dimension in research? Case studies in interdisciplinary research”<sup>8</sup>. In the report, examples of how and when gender has mattered in research are presented in a variety of fields, namely:

- Health and well-being
- Food, agriculture and fisheries
- Energy
- Transport
- Environment and climate
- Safe societies

Gendered innovation

Gendered innovation-website of Stanford university provides a checklist of how to address the gender aspects of any topic (see Appendix B). It is formulated for research, but the questions can be posed on the content (which is research) in any education programme. Here, some questions from the Gendered-Innovation website are translated into questions a teacher can pose in relation to the content of their course, and a few examples of answers from some sample fields are shown.

### **How do gender norms influence priorities?**

*What is important in the course? What is not important in the course?*

Example: Systems engineering

In a new program being developed at Chalmers for a Systems Engineer, different systems are included, and how they travel or expand. For instance the economic system, how it evolved from trading to monetary, and how the global financial market works. But it does not include the family as a system. When asked why not, the program developers explained that it is not a scalable system – they did not see how the family is the foundation of for instance our economic system, contemporary division of labour, or globalization effects.

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<sup>8</sup>[https://kjonnsforskning.no/sites/default/files/what\\_is\\_the\\_gender\\_dimension\\_roggkorsvik\\_kilden\\_genderresearch.no\\_.pdf](https://kjonnsforskning.no/sites/default/files/what_is_the_gender_dimension_roggkorsvik_kilden_genderresearch.no_.pdf)

**Who will the research benefit, and who will it leave out?**

*Who was the beneficiary/user/target of the research included in the course? Who was researched on?*

Example: Traffic safety research

Crash test dummies have for a long time been only male-bodied. Nowadays crash test dummies with female bodies exist, but they are only scaled-down versions of the male dummy. They do not account for the difference in fat distribution and bone density between male- and female-typed bodies. Moreover, females are sometimes pregnant, which makes it inappropriate to use a male-bodied crash test dummy to assess traffic safety for people with female-typed bodies. All these female body features have for a long time been excluded from research on car safety, leading to higher injury rates for women (eg. Bose et al., 2011). This example shows the importance to understand what lies behind the research and how it has been conducted.

**What (if any) “background assumptions” about sex and gender are shaping or embedded in the concepts and theories of the field? What are the implications of concepts and theories about sex and gender for how research is conducted in the field—that is, the choice of research topics, the methods used, what counts as evidence, and how it is interpreted? How do these concepts and theories contribute to Formulating Research Questions?**

*Am I (the teacher) aware of the background assumptions embedded in the concepts and theories of the field? If not: inform yourself, search for the research that reveals the biases in the current research and include it in the curriculum.*

Example: Traffic safety rules

Out of the five traffic safety tests that are required according to EU regulation, only one requires to be with a female-typed body, and it is only in the passenger seat. This reveals a gendered assumption about who uses cars as drivers: only men, and who is assumed to be travelling by car: mostly men. It is based on an outdated view on gender roles, and when looking at the higher injury rates for women reveals a gendered order in the eyes of the law, devaluing the life of people with female-type bodies. This example shows the importance of looking behind laws and regulations and question current practices, so that students in their future professional engagements are able to connect the dots to reveal discrimination that is embedded in current laws and practices.

Example: Butterflies

A female biologist was working on the reproductive behaviour of a particular species of butterflies. While conducting literature review, she noticed that previous studies recorded the male butterfly behaviour as being decisive for the reproductive habits. However, while conducting her own experiments, she realised that the average size of the female butterfly was much larger than the male one, and that the environment of the experiment mattered in terms of how free in space female butterflies were in order to increase reproductive behaviour. In fact, she determined that there was a bias in butterfly research pertaining to male butterfly

predominance in determining reproductive behaviour in most literature (Nieberding & Holveck, 2017). This example shows how old gender stereotypes (men as active, women as passive) has shaped our knowledge, and how those stereotypes continue to permeate our current knowledge production system.

**What issues related to sex and gender are not being addressed, or are being misunderstood or misrepresented, as a result of how concepts and theories are framed in the field?**

*Am I addressing the biases that are embedded in our current knowledge in the course?*

Example: Conception

We still teach human fertilization as a competition between sperms to penetrate the egg, although we know that the female reproductive system is just as (or more) active in the process: the egg helps to select the sperm that will penetrate it by producing an enzyme that helps the selected sperm and the lining of the uterus helps to push the selected sperm along (Martin, 1991). This example shows how old gender stereotypes (men as active, women as passive) has shaped our knowledge, and how those stereotypes continue to permeate our current knowledge production system.

#### 1.4 Learnings for supporting GruLg

When looking for examples of how gender aspects have been integrated into engineering education, most examples concern what is offered to the marginalized/diversified groups of students around their studies (support in the university context). This is not what the current project aimed at developing, but it is interesting to note that this, for many, is the first step towards gender equality. These offerings do have some merit, for instance safe spaces are valuable to build a sense of belonging among those that are marginalized (Harpalani, 2017; Palfrey, 2017), they only mitigate the negative consequences of inequality but do nothing to change inequality. As such they may actually counteract equality: While the negative consequences are mitigated, the problem seems less urgent, and inequality can persist.

When looking at the gender aspects of the *content* of engineering education, most of the developed material is about the *culture* where engineering/architecture “happens” (i.e. the work environment). This means an addition to the education, in order to make future engineers aware of the stereotyped and biased working places they will end up working in, so that they potentially may change the gendered order in the professional work.

However, **when looking at** all the gender-aspects of STEM *research* and from the research field of Gender and Technology, it becomes visible that learning about the work environment of future engineers is not enough: They must also understand something about **the gendered dimension of the output of their future work**. While the work environment dimension covers gender and diversity issues of how engineers work, the latter looks at the gender dimensions of

the output of engineers' work (for instance, a bridge). While the first has been developed extensively, the latter has not.

Based on the work that has been made to improve knowledge about the gender-related aspects of research, two learnings can be drawn of relevance for content-related aspects in engineering education. Firstly, it is important to find the gender-related aspects for each course/in each context. In each topic, in each course, the content will be different. It is not a question of finding different aspects of a gender inequality dimension established a-prior, such as for instance violence against women, or trafficking, the pay gap, or global inequalities, but understanding what, in each technological dimension, can have a different consequence for different groups (not only related to gender but also race, class, sexual orientation etc.). Therefore, the questions that researchers need to pose in relation to their research can be useful to pose also in relation to course content.

The second learning is that in order to teach researchers the gender-dimension of their research, examples are used. Examples may be such that they may be implemented directly, such as gender-aspects of traffic safety research and practices need to be included in courses of traffic safety, but the same example can also function as an inspiration for what teachers in other courses need to look for, such as gender aspects of a bridge, of telecommunication, of food safety, or biology research. Examples help teachers to see what kinds of questions they need to be asking about their own course subject.

In this report, a division is made between course content that relates to the work environment of engineers (*how* engineers work) and the subject matter (*what* engineers produce in their future work). While the first one relates to the power order and biased way that work is carried out in the field, such as pay gap, stereotypical task division, career obstacles, family life etc., the second relates to equality and power embedded in the output of engineers' work.

This distinction has not been made in other projects and therefore it may warrant addressing why it is relevant to make such a distinction. Most often, when changing the content of the education to make it more gender-sensitive, elements relating to the culture of engineering work (such as stereotypes and the gendered order) are added to the education. However, this leaves the knowledge we have of the gendered consequences of science and technology out. In Gender & Technology studies, we have a wide range of research showing how gender stereotypes are produced and reproduced through the artefacts and innovations that are produced. This is the content-related material that needs to be mainstreamed into education.

The main reason why we need to include Gender & Technology, (or feminist technology studies) research findings, and not only work with the cultural aspects of engineering work, is that we have been working with only cultural aspects for a long time: the many examples of gender dimension in the engineering education demonstrate this. And the change has been slower than we would have wanted.

One reason why the change has been slow is because gender-research is generally difficult to understand and utilize for engineers (Udén, 2017). Engineering teachers are generally not social scientists, and struggle to understand concepts such as culture, the performativity of technology and organizational forms or power in the work context. Therefore, it is difficult for the average

engineering teacher to include it in their course content. These issues then become separated from the regular education, and given by a teacher from a different field, outside of the subject-matter (such as the MTS-courses in Chalmers). This makes a division between engineering work and engineering culture – and the education fails to connect the culture with the output of engineering work. Therefore, the suggestion is to not only incorporate culture-related aspects of engineering work into the education content, but also alter the subject matter to consist of more gender-sensitive research.

The culture of engineering work and the output of engineering work are of course connected mutually constituted: The way work is carried out produces a culture and work is produced and affected by the culture where it is produced (*how* innovation is made **will affect and be affected by what** innovation is produced). This understanding comes from research on institutional change: Changing an institution (i.e. norms and culture that govern a certain field, in this context STEM academia) can be accomplished through a change of practices within the field (Zietsma & Lawrence, 2010), and practices and institutions are in an recursive relationship: Practices change institutions and institutions influence practices (Benford & Snow, 2000; Schatzki et al., 2001; Schatzki, 2006; Nicolini, 2012). By instilling new ways of interaction through bias training and stereotypes awareness, ways of working will change, which in the longer perspective, will change what is produced (the output). On the other hand, when we produce a different output, i.e. technology for new target groups, or technology that changes society and the power dynamics in society, then people will see the field of technology and innovation in a different way and other kinds of people may see engineering and architecture as viable career paths. This will cause more diverse student cohorts and engineers and architects will become a more diversified profession, which in turn will make the output of engineers and architects work more innovative, robust and tailored to more varied needs and perspectives.

The existence of a recursive relationship makes it possible to work with change in two ways: the current way (that has been tried for a long time) is by starting to change the culture of engineering production, while the other way (which is proposed in this project) is to change what we teach engineering students to produce. The learnings from this part of the project were used to develop the second part of the project: *Support GRULG in the continued work with a plan for gender education at Chalmers.*

## 2 Support GRULG in the continued work with a plan for gender education at Chalmers

The desktop research carried out to investigate how gender and diversity issues have been integrated into the education at other universities in Sweden and globally resulted in certain suggestions for how to do the equivalent at Chalmers. In the following, the change process proposed and implemented is presented.

### 2.1 Separate course or integrated?

Kortendiek (2011) proposed four different ways to integrate gender into the curriculum.

- Cross-discipline approach

The subject matter is analysed from other disciplinary angles. This could be a cross-discipline gender module, such as a class on the gender-sensitive use of media combining insight from Media studies, Social Psychology, Electrical Engineering, Pedagogy and Design, or a class where Hydraulic Engineering could be analysed in relation to development, globalisation, and gender.

- Integrative approach

Gender is merged with the subject matter, i.e. a Gender & Technology course in the specific area, such as ‘Mobility and Gender’, ‘Gender in Environmental Planning’ or ‘Energy and Gender’. These could include both the gendered output of the work in the field, as well as the issues of the culture where work in the field is produced. Integrating gender aspects in every discipline is recommended by most specialists in Kortendiek’s study.

- Individual explicit approach

Gender-specific modules, gender module components included across different courses. For instance gender modules/seminars on rural women and feminist critique of agricultural/forestry studies by collaboration with Economics, History and Social Sciences departments. This can be done when the competence of gender aspects is too low to produce an integrative approach.

- Explicit approach

e.g., BA/MA gender-studies programme, postgraduate degrees, PhDs Women’s Studies, i.e. a specialization on gender.

Several examples of universities offering courses that take a gender perspective on technology exist (the integrative approach). However, most often these courses are optional, as in the case of Chalmers. This makes taking a gender-perspective on technology a choice for students, as if there is two different approaches: The gender-sensitive and the gender-blind ways to make technology, and they are equally legitimate educational routes. However, gender-blind research *will* have a gendered consequence (eg. Anthony & Dufresne, 2007; Bose et al., 2011; Ah-King et al., 2014; Vera-Gray, 2018; Perez; 2019; Prasad, 2019; Wennberg et al., 2020). Both teachers

and students must understand this if the work of future engineers is to be inclusive for all kinds of people.

In order to integrate gender into the education beyond culture, and also regarding what we teach future professionals to do (i.e. the output of engineering work), it was suggested to start with integrating Gender & Technology research into other courses first (the individual explicit approach), and then offer an optional specialization course or programme (integrative approach), where some students develop deeper knowledge and an equality profile on their education. These can become future change agents.

## 2.2 One course in every bachelor program: gender-sensitive CONTENT

To start off, two workshops were held with GruLg, presenting the findings from the previous step regarding how gender can be included into engineering education. After analyzing UKÄ's evaluation texts, both the Chalmers review and those of other universities, it was estimated that what the UKÄ requested could be delivered by integrating the gender-dimension into at least one course in each Bachelor program. At Chalmers there is already a (compulsory)<sup>9</sup> course on pedagogics in higher education which includes a module on diversity, which is why the form was considered less important, and the content was in the foreground. Also, the UKÄ critique was regarding content, which is why this was decided to be a top priority.

The aim was to include content both on engineering culture *and* gender-sensitive research. The reasons for doing both, although most other examples only have focused only on the culture dimension, was multiple. First, gender stereotypes in the STEM fields have not yet changed despite integrating gender-sensitivity about the culture of engineering work: The labor market is still gender segregated in Sweden, and technical universities try to attract women to their educations by enacting gender stereotypes rather than by altering them. Altering the technological/subject-related content in the engineering education to more gender-sensitive could provide a new view of the knowledge and competence in the various engineering fields. This in turn would contribute to changing the gendered stereotypes connected to engineering in a different way and may speed up the change towards a more diverse engineering work force and new enactments of the engineering profession. Second, it was also identified in the interviews that many people felt that now was the time to take the next step and move from talking only about the culture of engineering to also talk about the consequences of engineers' work, that is, the consequences of technological output/innovation.

Given the complexity of gender education in a STEM context, and the fact that teachers in Chalmers generally are not educated in social sciences or gender & technology studies, it was assumed that teachers in Chalmers would need support to include the gender dimension in their teaching. A competence development effort was therefore proposed, which would provide a

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<sup>9</sup> It is compulsory for the pedagogical requirements in teachers' career development: but only for junior faculty since senior faculty already fulfil pedagogical requirements.

gender awareness to at least one teacher in each bachelor program, and where the teacher would make changes to their course.

This was designed into a workshop format, with two workshops and an extensive homework, where the teachers would do alterations to their own courses. By exiting daily routines into an alternative space (such as a workshop), it is possible to work with altering the routine work (courses). However, it is often difficult to connect knowledge that is developed in a workshop into daily work. To facilitate the process of implementing new things into established and taken-for-granted practices, it is fruitful to work with both reflective and experimental spaces (Bucher & Langley, 2016). In the reflective spaces, people reflect on the change they are engaging in, and in the experimental space they test the change. Then they return to the reflective space in order to reflect on the change, and modify it further, and so forth. Therefore the workshop was in fact divided into two sessions with an extensive homework, where the teachers would do alterations to their own courses.

Since the first part of the research had revealed many examples of how gender-blind research has caused biased results, the first workshop focused on presenting teachers examples from their own field, or examples they could use as inspiration. Examples were taken from the EU-projects as well as by a searching for examples that could be relevant within different fields, (see for instance Gendered Innovation under point 1.3). A methodology for searching for gender-sensitive research in their particular field was presented, and teachers were asked to find the examples that are relevant to their courses as a homework (providing an experimental space). In the second workshop they were asked to present what they found and what pedagogical elements they were planning to design for this new knowledge (the second workshop thus constituted a reflective space)<sup>10</sup>.

One solution to diminish inequality in classrooms was created by me during the course of the project – which then served as an illustration to make a distinction between superficial and real equality work. One teacher I came across, used a slide design for his course material, that made me rethink the setup in the classroom. The slide design is presented in Figure 1. Actually designing the classroom in the way that the teacher had designed the slide would allow students to pose questions anonymously in class. Students could pose questions through IT tools such as Mentimeter or Forms, and these questions could be projected on a screen in the classroom. This would make it easier for students that do not feel they have sufficient knowledge or legitimacy to speak up in the classroom.

However, when analysing this set-up, the diversity-related problem become apparent. This set-up would be a way to *diminish the consequences of inequality*, but it does *not improve equality* in the classroom: those that do not possess the sufficient confidence will not have their confidence boosted, and those that feel safe in their majority position will not be exposed to new kinds of voices (from bodies that previously were in the shadow).

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<sup>10</sup> The online material is found here: <https://chalmers.instructure.com/enroll/BYTET4> (self-enrolment link).

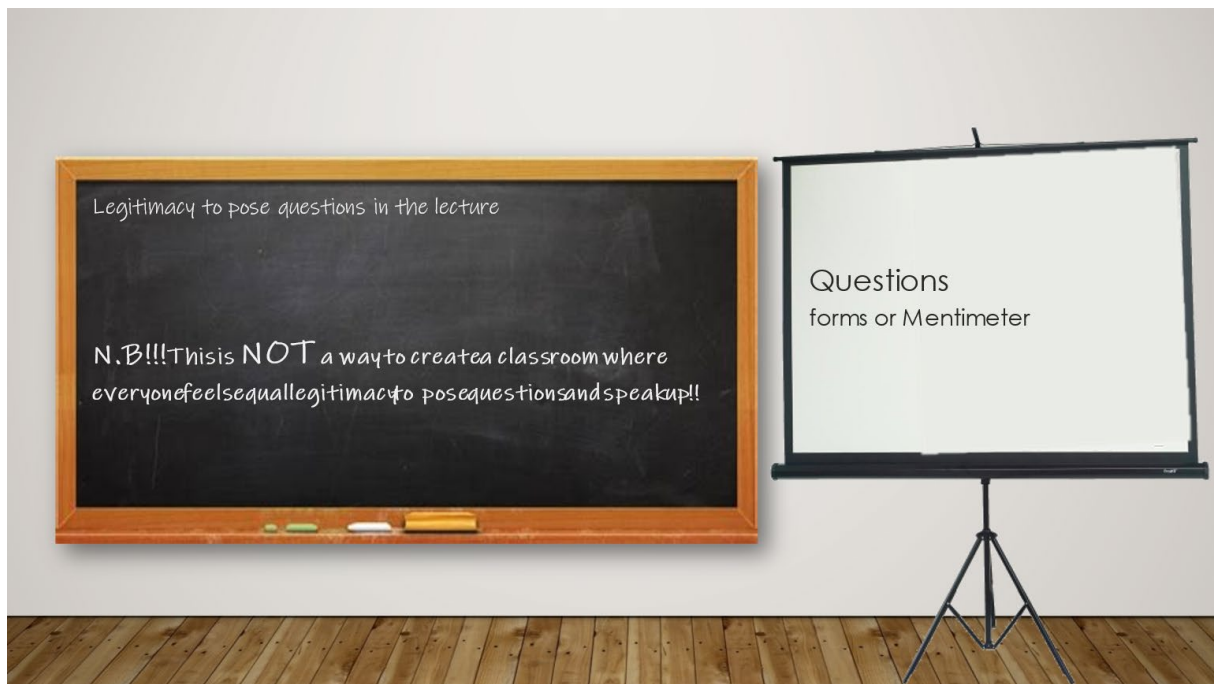


Figure 2 An attempt at equality in the classroom: anonymous questions

This is a solution that maintains the power relation between the majority and minority. Furthermore, it could also create a situation of unease for the teacher, if they themselves are a member of a minority group (Fotaki et al., 2014). This example was thus transformed into and used as a pedagogical tool in the teacher education to highlight the following: Including gender-equality into the education is not about covering up and easing the discriminatory effects of what we do (both in the classroom or in students' future professional practice). Instead, to work with diversity and inclusion, we must change those things that cause the inequality in the first place (the feeling of inferiority that make people shy to pose questions in the classroom for instance).

### 2.3 Set-up: theatre metaphor

In order to translate the findings relating to gender-aspects of *research* into gender-aspects of *engineering education*, a metaphor of the theatre was used (inspired by Hempel & Rysgaard [2013]). The theatre metaphor brings in a perspective of education that has three different spaces, or dimensions: frontstage, backstage and behind-the-scenes (see Figure 3).

The frontstage refers to our students' future work outcomes. We teach students to perform innovation/technology/products/etc. in their future roles as professionals. In the metaphor, we train them to perform on the frontstage in the future, where we acknowledge and are aware of the effect their future work efforts have on society (represented by the audience in the theatre). Equality and diversity on the frontstage means we teach students to create artefacts that take inclusion into account, i.e. algorithms that are not racist nor sexist, telephones that can be

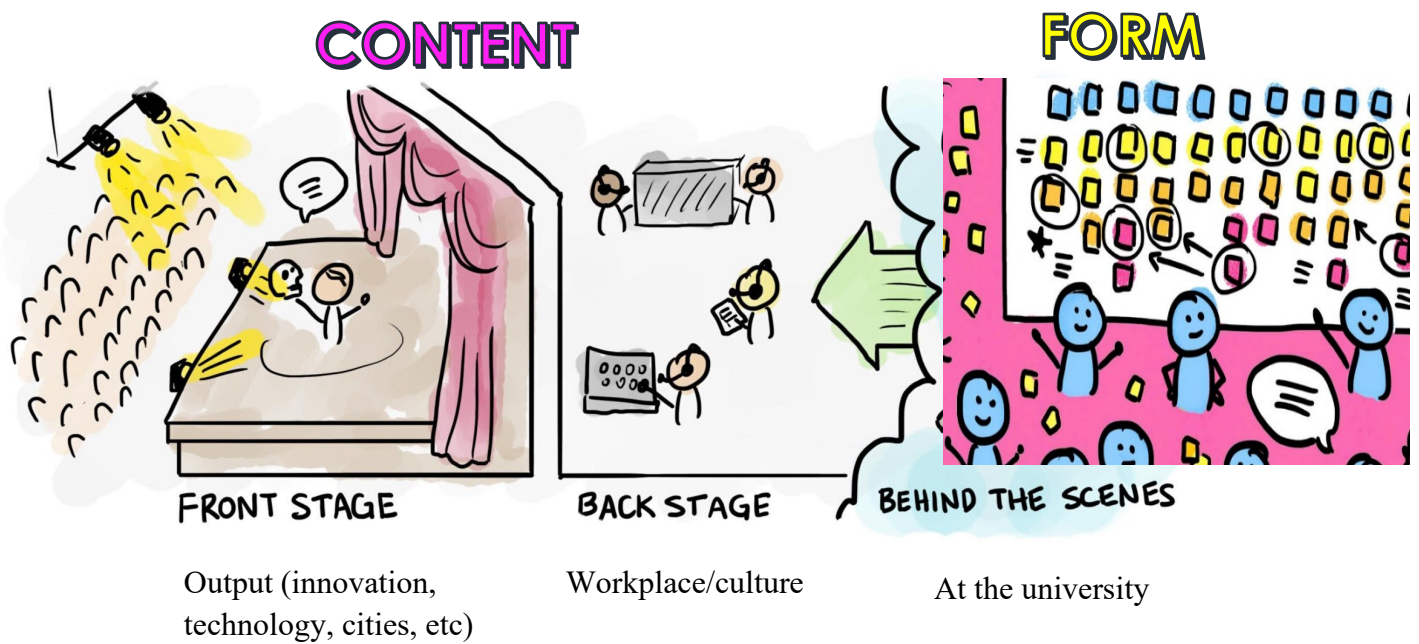


Figure 3 The theatre metaphor. Illustration courtesy of Practical Service Design [www.practicalservicedesign.com](http://www.practicalservicedesign.com)

operated with the same facility with small hands as large hands, cars that are just as safe for male-type bodies as female-type bodies, and self-driving cars that can recognize people with a variety of skin colors. In short, this is about *producing equitable technology/innovation/cities and so forth*.

Behind the frontstage is the backstage: the place where all the work happens that make the performance on the frontstage possible. In the metaphor, this are the future workplaces where our students will work. Equality content here relates to *equitable production of technology/innovation/cities and so forth*. Here we find the diversity of future workplaces, i.e. the issues that relate to the culture where engineers work. Both the frontstage and the backstage provide content-related changes, but the frontstage covers the gender aspects of the subject matter of the education while the backstage covers the stereotypes and practices that constitute the culture where engineering is made.

In the metaphor, gender in the education setting, for example inclusion in the classroom and fair assessments, is placed behind-the-scenes. The reason for this is that behind-the-scenes we are rehearsing and preparing students to become engineers. This relates to the *form* of education, such as legitimacy to participate, examination forms, pedagogy, didactics.

One important difference between the stage and behind-the-scenes is that what happens on the stage can be evaluated in the students works: behind-the-scenes is all about how we set up the learning situation and as such, if anything is examined here it is the teachers, not the students. The distinction between behind-the-scenes, front- and backstage is an analytical move that helps teachers to look at different aspects of their teaching and makes it easier to understand how and when to include gender in education. It helps to convey the message that the content of the education is of two types: the stuff that covers the work environment, stereotypes and pay gap, AND the stuff that comes from Gender & Technology studies: the inequalities that are

built into society through the work of engineers (such as unequal infrastructure investments, failure to include different bodies when designing houses, failure to consider different biological needs of different groups when designing public spaces, traffic safety etc.)

For more details on the set-up and content of the workshops, see Grzelec (2021).

#### 2.4 Facing resistance: community of practice

The reflective/experimental space loop could, in the longer perspective, be transformed into a community of practice (Wegner, 1999; Nicolini et al., 2022) which would provide teachers with a reflective space where they can discuss and develop new pedagogical solutions and share knowledge on a regular basis to continue developing their education (not only related to gender). Communities of practice exist where a group of people (teachers in this case) who share a concern or a passion for something they do (teaching) and learn how to do it as they interact regularly, meaning that they meet to share knowledge and learn from and with each other (such as at a pedagogical conference).

Building a community of practice also makes sense considering the resistance in the organization – many teachers still believe gender-sensitivity is not relevant in such an objective field as natural sciences, or that gender equality has already been achieved. Based on research on resistance, which tends to be high in academia and especially in STEM academia (Salminen-Karlsson, 2016; Drew & Canavan, 2020), it was suggested to work with the teachers that are most interested. The idea was to first engage and strengthen those that want to learn and develop, in order to build up a critical mass. Once some people start to engage, the hope is that others will see that there is a fruitful and interesting exchange and a teacher community, which then would attract more teachers to join. This would build community of practice, which is a common way to work with development and change within education systems (Gehrke & Kezar, 2017). By building a community that learn from and with each other, change is inevitable: “if you can impact the practice of large numbers of faculty, then change will eventually diffuse through the academy” (Gehrke & Kezar, 2017: 810)

In KTH the solution was different. They provided pedagogical resources and a helpdesk where teachers could come with their ideas and get feedback and individual coaching in changes made to their courses. This route was not suggested for Chalmers for mainly one reason: such a service-desk solution, while potentially providing excellent solutions for courses that are re-designed, it fails to build a community of practice. Since it is voluntary, it only engages those that are interested or have the time to make alterations in their courses. Instead, at Chalmers, the attempt was to frame it as a collective, group effort. Therefore, workshops were first held with Program Directors, and then the Program Directors were asked to pick those teachers that are interested and courses where it would be relevant to integrate a gender perspective. This way, the most reluctant teachers would not be forced to do changes, but those that are interested would have a group to do it together with.

### 3 Conduct a review of current research on gender in engineering education and envision a research agenda eligible for competitive grants

The third part of the project was carried out throughout the work with the other two parts. While investigating how others integrate gender and diversity into education, and developing the competence development effort, current research was reviewed. The result of this review is therefore found throughout this report and in the output of the project.

The review combined with the findings from conducting the competence development work, lead to a series of questions for future research.

#### 3.1 Engineers shape our future society

When presenting the theatre metaphor, teachers were somewhat confused because they most of them had previously thought about themselves on the front stage. They had a view of themselves as the performers: They were filled with knowledge that they would spread at a stage to their students. Now they were instead invited to think of their students in the same way: The education is filling students with knowledge and skills that they then, in the future, will perform in their future jobs.

Several teachers mentioned that it was eye-opening to think about their students as future engineers performing what they have learned at the university. Even if not all teachers understood the metaphor fully, it seemed pivotal in helping teachers to focus on what happens after the education. Most of them came in with a view that when talking about gender equality in engineering education, they would learn things that pertain to the education situation. In fact, even when discussing gender equality relating to the content of their courses, they would often return to talking about things such as group dynamics, examination forms, collaboration among students etc., i.e. the things that in the metaphor are placed behind the scenes. Then it was possible to help them zoom out from focussing on the university period and instead look at the future practice of their students, by recalling that they should look at the front stage.

#### 3.2 Reflexivity and critique in engineering education

One of the struggles was to help the engineering teachers to include a valuation in the teaching. Many of them could not understand how they can teach a reflexive/critical approach to their topic. For instance, one teacher in structural calculation of construction could not see that the thickness of walls or height of the kitchen desk has a gender equality aspect. He was presented with the analysis that the thickness of a wall will influence how much noise travels between apartments in a block of flats, and if more noise is allowed to sip through, others outside the family nucleus can become aware of violence or abuse in a family. This is a new dimension to think about when constructing a building. However, the teacher could not see how to include this: this was not part of the current curriculum or the current legislation, and therefore the teacher believed it was irrelevant. He could not see the need for reflecting on current legislation

in the course. In his view, his curriculum was to teach students to use the current rules and regulations, not to question them.

### 3.3 Desire for a quick-fix

Medical faculties have managed to include a gender equality perspective in a broad way: They have in several educations included the responsibility of care staff to recognize sexual abuse and domestic violence, as well as trafficking victims. One of the Pedul (Pedagogisk Utvecklingsledare) wanted Chalmers to define one such area, for instance domestic violence. I explained that would be very limiting: we need to teach engineers to pose the right questions whether they design a new car or work on food security. Moreover: we need to remember that our engineers shape society: discrimination in society takes many forms. Reducing it to one thing would not help the future engineers to recognize a discriminatory technology or practice when they see it. However, this Pedul was convinced that working with domestic violence would be a fruitful way to work within their education area and was going to continue with this pedagogical idea – to look for courses where domestic violence aspects can be included.

### 3.4 Biological explanation

The teachers showed a strong belief in essential differences between men and women. They did not themselves use the term “essentialism”, but they used biology and nature as arguments. They did understand that context and social coding has an effect on people, they still believed that a natural difference between men and women had a more significant explanatory power: The absence of women in the engineering education was a free choice based on skills and interests that come from birth – not from the schooling into gender roles that all people are born into. These ideals were still present even after showing how stereotypes are enacted by all people (Kahneman, 2011) and how some of the science which we believe to be objective and value neutral, actually has been guided by stereotypes and is biased: such as human fertilization (Martin, 1991), animal’s reproduction (Nieberding & Holveck, 2017), evolution (Hubbard, 1979/2003; Ah-King et al., 2014; Saini, 2017) and neuroscience (Joel et al., 2015; Fine, 2017). It was also shown to the teachers how people reproduce gendered stereotypes in STEM fields (Cardador, 2017; Gil- Juárez et al., 2018; Pietri et al., 2019; Wynn, 2020; Jansson & Sand, 2021). Despite explanation of how stereotypes are constructed and then interfere with our objective intentions, and all the examples that reveal this, teachers still believed that biology is a stronger explaining factor to the gendered nature of engineering and that women and men are different by laws of nature, rather than by laws of society.

### 3.5 General or specialist knowledge

When accepting that women are good at certain things (such as project management, societal concerns, and care) while men are better at others (the best students in mathematics are men, and men have more tech-interest overall) as laws of nature rather than socially constructed

laws<sup>11</sup>, the gender equality question came in conflict with the idea of what constitutes a good engineer. Teachers were eager to defend that the engineering education should be an education for specialists; NOT generalists. Given that women are better at/more suited to/more interested in generalist questions, making the education more tailored to women's skills and interests would deteriorate the education.

For instance, they would defend that there was no need to include leadership in certain engineering profiles because they would learn that on the job. What the education needed to focus on is the hard-core technological content. I tried to flip this idea: leadership is a complex and controversial practice which students need to be reflexive about – and this is something they only can learn in an academic context, while the hard-core technological content is to be found in books. Instead, I tried to reframe the question to become one of reflexivity: we need to include also a critical perspective on engineering work. I also tried to help them to stir things up and explain that since this is an education, we need to make sure that people leave from here with a broader set of skills than they came in with. The idea that it is ok that some become specialists (the best category) and some become generalists (second category) becomes a problem when it is always the same people that become best and always the same people that come second. That shows that our education is not giving people equal opportunities. But these alternative framings of the problem did not gain traction with the teachers: they immediately saw that the two options generalist or specialist engineers were at stake when talking about gender in the engineering education.

When approaching the gender equality issue with the stereotypical view of men as specialists and women as generalists (specialists being higher valued than generalists), the value of “what men do” is compared with the value of “what women do”. For the teachers in the workshops, this ordering was obvious: nobody was questioning the idea that specialists are more important than generalists. This is the gendered order of Hirdman (1988): the things that men do are valued higher than the things that women do. What is more, this framing of the gender equality issue reinforces stereotypes. It means accepting that there is a gendered division between men and women: They are good at/interested in different things. An alternative way to work with gender equality would be to question the division into male and female characteristics or predispositions (eg. Hirdman, 1988; Landman, 2007; Haines et al., 2016). It was difficult to help teachers to reframe the problem into these terms, however it may be an important step to take.

### 3.6 A home for nerds

Teachers also did not perceive there was a problem relating to the view of engineers as “geeks”, and the fact that such an image would deter others, non-geeks, from the profession (geek being a stereotype that men can enact more easily than women [Mendick et al., 2021]). One teacher could see that their students are a homogenous group of people which high-tech fascination or love of math, but this was the first time these people felt like part of a community: their whole

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<sup>11</sup> A law of nature being sedimented while a socially constructed law can be altered.

education period these people have been the odd nerds. Finally they were one among similar peers. Therefore, there was no point in working to get rid of the nerdiness associated with engineering. I said that if these people have been the odd ones in their previous schooling period, they know what it feels like to not fit in and therefore we have an excellent ground to work with inclusion: We have people that have experienced exclusion themselves. The answer to this attempt to work with the experience of the geeky students was not picked-up by the teachers. Instead, they said “well, is the reason for people feeling excluded from our education the culture or the content? I believe the content.”, which another teacher also echoed (observation notes 2021-11-18). They could not think of themselves as part of a culture and creators of a culture where some people will feel comfortable, while others will feel as foreigners or visitors.

### 3.7 Smörgåsbord education

Some of the most prominent universities in Times Higher Education ranking regarding gender parity (THE, 2020) and with 50% female representation (Graham, 2018) have special pedagogical profiles and program setups. For instance, two of the top five engineering educations offer a buffet of directions (a “smorgasbord”), rather than the more static programmes of the Bologna model followed in EU, where overarching title for professions still dictate the content: It is not a title the student crafts for themselves. When allowing more options, these gender-equality top-ranked universities have been able to attract more women, and this is thought to be connected to the ability to cut with the traditional view of engineers, allowing for more variation in identification. Put simply, a wider range of people can imagine doing engineering education when it is framed as something more free, new, creative, and individual than the traditional engineering education. This aligns well with feminist approaches to knowledge creation: knowledge is not what resides in academic minds or university buildings, but lay people have intelligence to contribute to define what it is. It also aligns with current pedagogical methods, where knowledge is co-created and students sometimes take an active role in constructing the syllabus. Therefore, the smorgasbord-approach may be an interesting avenue for engineering education reforms. This may produce engineers that are different than those that are currently requested from the industry – but this may not be a negative thing. The engineers that come out of the university will create new innovations, business ideas and business models instead of entering current companies and fields.

## Project effects/output

- An education for teachers at Chalmers was designed and delivered on how to integrate Gender & Technology studies into the regular engineering and architecture courses. This was a spin-off from the project, funded by GruLg. It has produced the following effects:
  - Conversation about gender and diversity aspects of technology were initiated among the participants in the workshops.
  - Several participants learned about the distinction between form and content in their courses, which is an important basic understanding in order to start working with content-related changes.
  - 71 teachers participated and thus increased their competence about gender and technology in their course content.
  - A basis for Communities of Practice was laid.
  - Circa 50 courses and programs have been assessed by the participants in the workshops.
  - Extensive online material has been developed in Canvas. The online material is found here: <https://chalmers.instructure.com/enroll/BYTET4> (self-enrolment link).
  - The news about this work is to be found here: <https://student.portal.chalmers.se/en/News/Pages/Gender-equality,-equal-treatment-and-diversity-made-clearer-in-education.aspx>
- 2021 KUL Conference on teaching and learning at Chalmers. A workshop was held, entitled *If gender equality is not about quantity – then what is it about?* This workshop focused on qualitative gender equality in STEM education, and work with participants own ideas or concerns relating to gender equality solutions in teaching, as well as current state-of-the-arts practices and research findings. Slides are available here: <https://easychair.org/smart-slide/slide/38JJ#>

### Publications

Grzelec, Anna (forthcoming) Doing gender equality and undoing gender inequality – a practice theory perspective. *Gender Work and Organization* (accepted 22-10-22) DOI: 10.1111/gwao.12935

Grzelec, Anna (2021). Comprehensive and practical method for integration of Equality, Diversity and Inclusion (EDI) into engineering education. In proceedings from *8:e utvecklingskonferensen för Sveriges ingenjörutbildningar*, Karlstad 24-25 november [https://www.kau.se/files/2021-10/full\\_paper\\_36171\\_f6c9c7df-f939-4a62-a518-3ff6124b743a.pdf](https://www.kau.se/files/2021-10/full_paper_36171_f6c9c7df-f939-4a62-a518-3ff6124b743a.pdf)

### Papers in progress

Draft title: “Gender inequality in a gender equal society: learnings from practice in Sweden” (Target outlet: a policy journal, eg. *Global Policy*, *Journal of Public Policy*)

This paper aims to feedback to policy makers on the effects of counting women as a gender equality measure. Using the number of women (students or professors, for instance) is common from various authorities in Sweden (eg. UKÄ, JÄMY) and has unintended consequences which cause gender inequality. Policy makers need to be aware and wary of this key performance

indicator that is often used. One example of a gender equality measure that has been implemented in Swedish universities to raise the number of women in faculty positions is that a position will only be filled if there is at least 30% women applicants. However, this in reality becomes an inequality measure asking women to prepare (often extensive and complex) application material, to apply for positions which they will not get anyway (Van den Brink & Benschop, 2012; Nielsen, 2016) as long as evaluation criteria are changed.

Draft title: “Future-forming engineers – performativity of gender stereotypes from education to practice” (Target outlet: *Futures* or *Teaching in Higher Education*)

This paper elaborates the theatre metaphor as a method to understand the performative aspect of engineering and the gendered consequences of the education.

### **Applications**

Vetenskapsrådet 2021

Forte 2021

## Recommendations

- Further development of teachers' familiarity with Gender & Technology research in their own expertise area.
- Further integration of Gender & Technology research into subject topics in all relevant<sup>12</sup> courses at Chalmers.
- Creation of Communities of Practice (CoP) within the four different education areas (EDITI, MATS, KFM, ASAM), where teachers get together to reflect on their practice, develop their practice, and learn from/with each other. This would include sharing Gender & Technology research with each other, but also other pedagogical and content-related issues. Program development, which already takes place and where teachers collaborate on a program level, can be part of the CoPs. The CoPs would complement the current pedagogical annual conference KUL, by staying closer to the practice of teachers, and not include a publication/peer review process which creates extra pressure to have pedagogical ideas ready to be shared. In the CoP teachers could collaborate in their daily course development work in a less prestigious way, with half-baked ideas or challenges.
- Investigate the usefulness of a certification scheme for Chalmers' education. This could be based on the theatre metaphor with three dimensions of certification:
  - a) **FORM:** learning situation  
*Aim:* to certify teachers' competence to teach in an inclusive way. It would evaluate:
    - a. whether the teacher is reproducing gender stereotypes or not (e.g. Images and examples used, who is included in the research that is included in the course material used by the teacher etc.)
    - b. what happens in the learning situation (e.g. Is the teacher using methods to create legitimacy for all students to participate? Is the teacher using a variety of examination forms? Is the teacher using pedagogical tools and methods that support students' various learning styles? Etc.)
  - b) **PROGRAM CONTENT:** workplace culture  
*Aim:* certify whether the program covers questions about practices for fair and just collaboration and inclusion in the workplace i.e. that the program teaches "equal production of innovation/technology/cities etc.". Every programme should have this certification.
  - c) **COURSE CONTENT:** gender-sensitive research  
*Aim:* certify whether the course has incorporated gender-sensitive/Gender & Technology research into the course, i.e. that the course teaches "production of equal innovation/technology/cities etc.". Having one such course in each program would satisfy the level of ambition that has been defined by GruLg at this time. Later the level of ambition could be developed further, such as for instance 50%.

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<sup>12</sup> Relevant are all courses where gender-sensitive research exists, and/or where the content has been studied in the Gender & Technology field.

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## Appendices

### Appendix A: Projects

Swedish partners are highlighted. Presented in a chronological order, starting with the most recent.

2016-2020	PLOTINA	Promoting gender balance and inclusion in research, innovation and training
University of Bologna (IT), University of Warwick (UK), National institution of chemistry (SL), University of Mondragon (ES), University of Ozyegin (TR)		
2016-2020	Baltic Gender	Promoting Gender Equality in Marine Research Organisations
GEOMAR Centre for Ocean Research Kiel (DE), University of Tartu (EE), Kiel University (DE), Kiel University of Applied Sciences (DE), Klaipėda University (LT), <b>Lund University (SE)</b> , Finnish Environment Institute (FI), The Leibniz Institute for Baltic Sea Research (DE)		
2018-2020	FIAGES	Feminist Institutional Approach to Gender Equality in STEMM
Trinity College Dublin (IE)		
2017	STING	STEM Teacher Training Innovation for Gender Balance
Elhuyar Foundation (ES), European University Cyprus (CY), Experimentarium (DK), Hacettepe University (TR), NEMO Science Museum (NL), Norwegian University of Science and Technology (NO), Saint Mary's University College Belfast (UK), Ustanova Hiša eksperimentov (SI)		
2016-2019	EQUAL-IST	Gender Equality Plans for Information Sciences and Technology Research Institutions
ViLabs (GR), Ca' Foscari, University of Venice (IT), University of Muenster (DE) University of Liechtenstein (LI), University of Turku (FI), Kaunas University of Technology (LT), University of Modena and Reggio Emilia (IT), University of Minho (PT), National University of Economics (UA)		

2016-2019	SAGE	Systemic Action for Gender Equality
Trinity College Dublin (IE), Università degli Studi di Brescia (IT), Kadir Has University (TR), Instituto Universitário De Lisboa (PT), Sciences Po Bordeaux (FR), International University of Sarajevo (BA), Queen's University Belfast (UK)		
2016	Erasmus+ strategic partnership	Diversity in the Cultures of Physics
Freie Universität Berlin (DE), Universitat Autònoma de Barcelona (ES), Universitat de Barcelona (ES), University of Manchester (UK), University of Sheffield (UK), <b>Uppsala Universitet (SE)</b> .		
2015-2019	LIBRA	Leading Innovative measures to reach gender Balance in Research Activities
Centre for Genomic Regulation (ES), Austrian Academy of Sciences (AT), Institut Curie (FR), The Babraham Institute (UK), European Institute of Oncology (IT), Biotech Research and Innovation Centre (DK), Friedrich Miescher Institute for Biomedical Research (CH), Max- Delbrueck Center for Molecular Medicine (DE), Central European Institute of Technology (CZ), The Netherlands Cancer Institute (NL)		
2015-2018	Gen-Era	Gender Equality Network in the European Research Area
Deutsches Elektronen-Synchrotron (DE), Netherlands Organisation for Scientific Research (NL), Karlsruhe Institute of Technology (DE), Portia (UK), National Institute for Nuclear Physics (IT), Max Planck Society (DE), Joanneum Research (AT), Instituto de Astrofisica de Canarias (ES), University of Geneva (CH), National Research Council (IT), Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (RO), Jagiellonian University (PL), National Center for Scientific Research (FR)		
2012-2017	FESTA	Female empowerment in Science and technology academia
<b>Uppsala University (SE)</b> , University of Southern Denmark (DK), RWTH Aachen University (DE), University of Limerick (IE), Fondazione Bruno Kessler (IT), Istanbul Teknik Universitesi (TR), Southwestern University (BG)		

2014-2017	EGERA	Effective Gender Equality in Research and Academia
Sciences Po (FR), Universitat Autònoma de Barcelona (ES), Radboud Universiteit (NL), Middle East Technical University (TR), University of Antwerp (BE), University of Vechta (DE), Global Change Research Institute CAS (CZ), Centro de estudos para a intervencao social (PT)		
2014-2016	GARCIA	Gendering the Academy and Research: Combating Career Instability and Assymetries
University of Trento (IT), Université catholique de Louvain (BE), Radboud University (NL), University of Iceland (IS), University of Lausanne (CH), Slovenian Academy of Sciences and Arts (SI), Joanneum Research (AT)		
2015-2018	Gen-Era	Gender Equality Network in the European Research Area
Deutsches Elektronen-Synchrotron (DE), Netherlands Organisation for Scientific Research (NL), Karlsruhe Institute of Technology (DE), Portia (UK), National Institute for Nuclear Physics (IT), Max Planck Society (DE), Joanneum Research (AT), Instituto de Astrofísica de Canarias (ES), University of Geneva (CH), National Research Council (IT), Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (RO), Jagiellonian University (PL), National Center for Scientific Research (FR)		
2013-2017	Gender Time	Implementing and monitoring future Gender Equality Action Plans in scientific and education institutions
Egalité des Chances dans les Etudes et la Profession d'ingénieur en Europe (FR), Inter-University Research Centre for Technology, Work and Culture (AT), University of Padua (IT) <b>Linköping University (SE)</b> , University Paris Est Créteil (FR), Mihailo Pupin Institute (RS) Bergische Universität Wuppertal (DE), Loughborough University, (UK), Tecnalia Research & Innovation (ES), Donau-Universität Krems (AT), <b>University of Gothenburg (SE)</b>		
2013-2016	Genovate	Transforming Organisational Culture for Gender Equality in Research and Innovation
University of Bradford (UK) , University College Cork (IE), <b>Luleå University of Technology (SE)</b> , Università degli Studi di Napoli (IT), Ankara University (TR), Trnava University (SK), Universidad Complutense de Madrid (ES)		

2013-2016	GENDER-NET	Promoting gender equality in research institutions and integration of the gender dimension in research contents
<p>Integrating the <b>Gender Analysis into Research (IGAR)</b> tool: <a href="http://igar-tool.gender-net.eu/en">http://igar-tool.gender-net.eu/en</a> developed by 4 ministries (FR, ES, SI, (IL) , 7 National research organizations, agencies, authorities, councils (FR, NO, IE, BE, CY, CA, US) 1 state secretariat (CH) and 1 National charity organization (UK) and 10 observer organisations</p>		
2011	UNESCO-CEPES	European Center for Higher Education: Studies on Higher Education
<p>All Europe. Publication of <i>From gender-studies to gender IN studies. Case studies on gender-inclusive curriculum in higher education</i></p>		
2009-2012	Gendered Innovations	How Gender analysis Contributes to research and innovation
<p>European Commission, DG Research &amp; Innovation (2011–2012), National Science Foundation (2012) US, Stanford University (2009–2010) US. 62 reserachers engaged, among others  -Tomas Brage, Physics, Lund University  -Annika Carlsson-Kanyama, Industrial Ecology, KTH</p>		
2009-2012	Gender in EU-funded research	Toolkit and Training
<p>Yellow Window consultants (FR, BE)</p>		

## Appendix B: Checklists

**For applying gender-sensitive approach**

**in CURRICULUM:**

- Are you inviting a balanced number of female and male academics for a visiting lecture at your course?
- Have you invited a visiting lecturer renowned for his/her gender-sensitivity?
- Do you attract students of both genders to take your course?
- Are you stimulating students to work in gender-mixed groups?
- Do you prepare your students to be gender-sensitive professionals one day?
- Have you included in the course reader gender-sensitive publications?
- Have you devoted at least one class to gender dimension of the course topic?
- Do you make your students more aware about gender stereotypes connected to the field you teach?
- Do you make your students aware about gender inequalities they will face one day as professionals?
- Do you teach students gender-sensitive methodology?
- Do you use gender-sensitive language and visual materials while teaching and writing course materials?
- Does your Handbook contain gender dimension of the course topic?

Mihajlović Trbovc, J. & Hofman, A. (2015) *Toolkit for Integrating Gender-Sensitive Approach into Research and Teaching*, GARCIA working paper n. 6

## 4 | Checklist from all “Take aways”



- ♦ Gender-sensitive teaching is concerned with teaching content, materials, methods and the interaction between teachers and students with the aim of offering all students - regardless of their gender - the best possible study conditions so that they can fully develop their individual talents and potential.
- ♦ Reflect on your own internalised gender stereotypes and the unconscious biases you might have about an individual, group or institution. Challenge normative assumptions in your teaching practice to break patterns of thinking.
- ♦ Include examples from women's as well as men's contributions to sciences in your teaching.
- ♦ Gender biases can be minimised or eliminated by the systematic integration of gender aspects and disclosure of inequalities into the curriculum.
- ♦ Find the appropriate approach for incorporating gender aspects into the curriculum; e.g., as cross-cutting issues into the existing fields of study, as a specific gender degree programme, as a comprehensive gender module for several degree programmes, as an independent module within a degree programme.
- ♦ Standard teaching materials tend to use gender stereotypes; instead, use gender-balanced images and gender-neutral language.

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- ♦ In terms of diversity aspects in contents and materials, lecturers should check whether diversity categories such as gender, age, disability, ethnicity/race, social origin, religion/belief and sexual orientation are explicitly addressed, or whether examples are selected that represent the diversity of people.
- ♦ Participatory teaching invites the use of cooperative and interactive methods instead of just teaching from the front. Make sure that you use a variety of media and stimuli: switch between more cognitive and more practice-oriented approaches so that what students have learned can sink in through reflection, feedback and repetition.
- ♦ There is evidence that a project-based learning curriculum may boost female success in STEM fields. In general, it can be said that project-based learning contributes to better learning outcomes for all students regardless of their gender. It gives students the opportunity to develop knowledge and skills through challenges and problems they may face in the real world.
- ♦ Inclusive teaching requires the lecturer(s) to adapt to students' individual biographies and learning needs, thereby taking the changing needs of different student groups into account.

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## CHECKLIST

### THE SEX/GENDER DIMENSION IN RESEARCH

#### RESEARCH IDEAS PHASE

- Have you considered how assessments of sex/gender, including stereotypes about what is considered “female” or “male”, can affect what you want to investigate, what questions you ask and how to answer them?
- Is sex/gender important for understanding the phenomenon you will investigate, and if so, how? Are there other dimensions that can be considered in relation to sex/gender, such as age, ethnicity, educational level, income, occupation, geographical location or technical competence?
- Have you reviewed literature and other sources relating to sex/gender in the research field?

#### PROPOSAL PHASE

- Does the project’s research topics and methods take the sex/gender dimension into account? Does the proposal explain how the sex/gender dimension will be handled?
- Are researchers trained in gender studies included in the research group?
- Have you considered whether the results of the research can have different effects on women and men, boys or girls? Can the research contribute to the advancement of gender equality?

#### RESEARCH PHASE

- Are research methods, such as questionnaires, focus groups, etc., designed in a way that considers possible sex/gender differences and similarities between gender? Will sex/gender-differentiated data be collected? Have you ensured that samples, test groups or other involved in the project are diverse in terms of sex/gender, age and other background variables?
- Will sex/gender be a variable in the analysis? Will other variables be included in relation to sex/gender in the analysis?
- Are unconscious (stereotypical) assumptions about sex/gender implicit in the interpretation of data? Are there dimensions other than sex/gender that are important to consider?

#### DISSEMINATION PHASE

- Is the sex/gender dimension included in the presentation of findings?
- If the sex/gender dimension is included, is it done in a way that does not reproduce stereotypical notions about gender, but also looks at variations within the gender categories?
- Have you considered that dissemination of the research findings can be directed towards networks, institutions, journals and conferences that address gender issues?

## Checklist

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- Do the images and examples of scientists in your talk or activity showcase a range of diverse people?
- If you need to monitor the gender of people who attended your event, have you put an inclusive system in place to collect this information (rather than assuming you can tell by looking)?
- Have you highlighted a range of real-world applications?
- Have you thought about how you're going to handle questions, ask for volunteers, or assign roles in group work?
- Have you included a variety of activities or styles of teaching?
- Has everyone delivering the activity either received training in or been briefed on diversity & inclusion?
- Are there role models in your event, e.g. in the people delivering the activity or highlighted in your examples?
- Have you thought about inclusivity beyond gender—such as how accessible your event is to people with disabilities? Or representation of role models from ethnic minority groups?

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## Making physics outreach more gender inclusive



Erasmus+ Strategic partnership Diversity in the Cultures of Physics, flyer

[https://www.genderportal.eu/sites/default/files/resource\\_pool/genderphysicsoutreach\\_flyer\\_diversityculturephysics.pdf](https://www.genderportal.eu/sites/default/files/resource_pool/genderphysicsoutreach_flyer_diversityculturephysics.pdf) (accessed 2022-10-30)

## Engineering Checklist from Gendered Innovation website of Stanford University

[http://genderedinnovations.stanford.edu/methods/engineering\\_checklist.html](http://genderedinnovations.stanford.edu/methods/engineering_checklist.html)

(accessed 2022-10-30)

### Key Questions

1. Potential consumers of technology have different characteristics ([gender identities](#), [sex](#), age, [ethnicity](#), profession, occupation, education, income, household and living arrangements, familiarity with and attitudes towards technology, etc.) What role, if any, do these factors play with regard to the developing technology? (see [Analyzing Research Priorities and Outcomes](#); [Intersectional Approaches](#), [Norm-Critical Innovation](#))

#### (A) Determining the Relevance of Sex

2. Are there basic anatomical and physiological differences between women, and men, and non-binary individuals that should be considered (e.g., in height, strength, range of motion, etc.)? (see Term: [Sex](#); see Methods: [Analyzing Sex](#); [Rethinking Standards and Reference Models](#))

3. Are there further anatomical and physiological differences between women and men that should be considered (e.g. in vision, hearing, voice pitch, sense of touch, smell, and taste, proprioceptors, muscular tension, temperature perception, etc.)?

#### (B) Determining the Relevance of Gender and Other Intersectional Factors

4. What are the potential application areas of the technology (e.g., professional life, leisure activities, home, etc.)? Do these contexts suggest different patterns of use by different groups of potential consumers? See Term: [Gender](#); see Methods: [Analyzing Gender](#); [Intersectional Approaches](#).

5. Might different groups of potential consumers (e.g., non-binary individuals, women, or men, old or young, etc.) have different expectations regarding the interface? Do certain features of previous innovations reinforce existing gender inequalities, [gender norms](#), or stereotypes? (see [Reformulating Research Questions](#); [Participatory Research and Design](#))

6. Might different groups of potential consumers have different expectations regarding the exterior design?

7. Might different groups of potential consumers have different expectations regarding the features and functions?

8. Is it more cost-effective to tailor the technology to specific groups at early development stages or could it be inexpensively adapted in post-development?

9. Is there a risk of stereotyping or offending potential consumers through the exterior design (e.g., imposing role models, avatars, different forms of sexism, or racism etc.)?

10. Is there a risk of excluding certain groups (e.g., the elderly) through the technology design?

11. Would certain configurations reinforce existing social roles (e.g., gender segregation in the work force; men associated with engineering and women with domestic technologies, for example)?

12. On the basis of the above, what are the relevant sex, gender, or intersectional variables for your business, and what do you need to know that you do not currently know or understand concerning these factors?

### **(C) Determining the Tools Required**

13. Is it possible and/or necessary to establish a usability lab or to run ergonomic tests? What additional tools might you use for monitoring (questionnaires, workshops, etc.)?

14. Have you ensured diversity within test groups (in terms of age, sex, gender identity, ethnicity, height, etc.)?

### **(D) Determining the Potential for Innovation**

15. Can you think of any additional customer groups or application areas for your technology?

16. How much research would be necessary to identify those groups/markets?

17. Is your business model missing potential opportunities by not addressing sex, gender, or intersectional factors sufficiently? Where might analyzing these factors open up new business opportunities through Gendered Innovation?

### **(E) Procuring Sex and Gender Expertise**

18. Have you identified the particular gender or other types of expertise you require?

19. Do your internal and external teams include the needed gender expertise? If not, what efforts are your teams making to bring in gender specialists?

20. Do members of the target group(s) have particular expertise relevant to developing or applying the technology that should be incorporated into the innovation process?

21. What efforts is your team making to ensure that the diverse expertise, interests and needs of the target groups are incorporated into the design and development of the product? (see [Co-Creation & Participatory Research](#))

22. Do certain groups hold knowledge (e.g., because of gendered or age-specific divisions of labor) with the potential to prevent unwanted outcomes, such as increased social inequalities or environmental damage?

23. What efforts is your team making to ensure that it learns from the inputs of external expertise concerning sex, gender, and intersectional analyses, and builds relevant capabilities in-house?

24. Does your team understand how to incorporate gender expert knowledge and innovation criteria into existing design, engineering and quality methods such as Quality Function Deployment (QFD), Failure Mode Effect Analysis (FMEA), or Six Sigma?



# KTH SCHOOL OF ARCHITECTURE – RULES ON GENDER EQUALITY AND DIVERSITY

These rules apply: 2018-2019-2020

## Our Five-Point Gender Equality Checklist

Gender equality does not pose a threat to quality in our chosen field; it is about improving quality through greater choice. Everyone who is in any way active at the School of Architecture can give consideration to who they choose to refer to at any given point in time.

1. **Think about who, or what, you display as a reference, and why.** Consider what or who the image/lecture/critique omits, and why. Always examine the completed text/lecture/presentation/image/task formulation/appointment with a gender-balanced and inclusive gaze. What perspective do you have on the issue at hand? Do you need to make any changes in order to create gender equality and diversity?
2. **Travel outside of your normal network** to create a gender balance among participants on discussion panels and juries, at seminars, conferences and reviews.
3. Bear in mind that you should **move seamlessly when highlighting architects of both genders.** Avoid segues such as, “and now, we come to a female architect”. Instead, move on naturally with no particular emphasis.
4. **Name or cite women and men in the same way,** always initially using both first and last name and subsequently either both names or first name only. Remove superfluous value words or gender-specific expressions.
5. **Consider how you converse with or ask questions of students.** Always maintain a positive tone that shows respect for every student as an individual. Is there a risk that the person you are speaking to may perceive you as exclusionary? If so, consider whether there is something you can change about your interaction.