Diversifying a Car Body Development Course

Integrating Intersectional Gender Studies Expertise in Engineering Education

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Keywords: Gender in engineering education, intersectionality, car body development course

INTRODUCTION

In December 2012 the Maria-Goeppert-Mayer chair for “Gender, Technology and Mobility” was established at the TU Braunschweig and the Ostfalia University of Applied Sciences, Germany. The work group is partly financed for four years by a larger program of the federal state Lower Saxony that aims at strengthening the field of gender studies within academia. Central to the team’s work is to foster a constructive dialogue between gender studies and engineering in order to integrate gender studies knowledge into engineering education and research & development, with a special focus on mobility technologies.

The TU Braunschweig constantly seeks to improve education regarding content and educational practices alike. The university successfully applied for funding from the German federal ministry for education and research for a program “Teach4TU”.This program includes annual subprogram facilitating processes of innovation within the university’s courses. To participate, Prof. Dr. Bath’s work group collaborated with Prof. Dr. Vietor (Institute for Engineering Design); they shaped a pilot scheme called “GenderING. Gender Studies in Engineering Sciences” (ING refers to the German term *Ingenieurswissenschaften*=engineering sciences). The innovative aim of this project is to integrate knowledge derived from intersectional gender studies into a regular university engineering course (exemplarily in the course “Introduction to Car

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Body Development"). In the 'GenderING' project, gender studies is understood as a means for reflection, especially on in- and exclusions and on marginalized positions in engineering projects. Thus, gender studies help to make formerly invisible or neglected topics visible. Furthermore, gender studies question hierarchies and power structures and emphasize the diversity of people, situations and contexts.

Interdisciplinary bridges between engineering knowledge and gender studies can broaden both disciplines. When they reach beyond measures for gender equality in engineering, these bridges have barely been built. Gender and diversity still are underestimated topics in engineering research & development, and accordingly do not enter engineering education. Examples, such as the development of crash test dummies that were originally standardized to male and non-pregnant bodies, demonstrate that one-dimensional or stereotypical assumptions about target groups can lead to poor usability, problems of acceptance or economic failures, and even dangers for users[2]. Empirical studies show that a social and historical contextualization of technological knowledge improves engineering education. A shift in the content of engineering courses requires a didactical reconceptualization of the courses as well. Ideally this would be based on research-oriented, problem-based learning and interactive teaching styles.

In the first six month of the projects we focused on developing a new course concept, starting with a reevaluation of existing lecture material, which is followed by enriching it by confronting the material with intersectional gender studies knowledge and methodology. During the next six months we will test the concept with approximately 80-100 mechanical engineering students, while constantly evaluating and improving the concept in order to transfer ideas to other engineering courses. Interestingly, what we found with the project 'GenderING' so far is that connecting gender and diversity aspects with the content of the lectures seems easier than restructuring the teaching concept.

This paper is structured as followed: First, we discuss gender studies as a means for reflection in engineering and the potential of this understanding for bridging the social and the technical. Second, we introduce our general approach to the 'GenderING' project, present connecting points between gender studies and engineering in the car body development course and teaching objectives. The third and last part discusses challenges of the project.

1 GENDER STUDIES – A MEANS FOR REFLECTION

1.1 Gender and intersectionality

Gender is a powerful structuring category. In Western countries, for example, access to technological fields and expertise has a strong gender bias. The background for this is, simply put, a cultural history which attributes culture, technology, constructing, etc. to men, and nature, sociality, caring etc. to women [1]. Many initiatives address this question of *women in technology*[3] and strive for more gender equality. In the specific case of access to the field, it might make sense to single out one aspect of identity such as being a woman, because of its impact.

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[2] For a deeper analysis of gender aspects and usability, see: N. Marsden; U. Kempf (2014) (ed.), Gender-UseIT. HCI, Usability und UX unter Gendergesichtspunkten, De Gruyter, Berlin, München, Boston, Mass.

[3] In Germany, many of these initiatives are currently coordinated by the program "Komm mach MINT" (MINT = STEM) at the competence center for technology, diversity and equal opportunities

When it comes to addressing gender as a structural category in society at large, however, a more complex picture is needed. Feminists of color, in particular, have pointed out that talking about men and women most often implies white people [2]. Generalized assumptions about men and women tend to neglect that gender is embedded in a network of social categories, as well as it neglects questioning the gender binary as such. The term diversity is used by corporations and institutions alike to describe that humans obtain a variety of ethnic and social backgrounds and that they differ, for example, in sexual orientation, abilities, age, state of health and lifestyle choices.

To highlight the intertwining of these categories, the academic concept of intersectionality evolved which "implies more than […] studying differences between women and men, and more than diversities within groups of women or within groups of men. Intersectionality tries to capture the relationships between socio-cultural categories and identities [3]. Instead of just adding one social category to another, this approach focuses on the crossing points of social markers and the power relations, hierarchies and politics of in- or exclusion connected with these.

Social categories themselves are not fixed entities. Their attributed meaning changes throughout history or depending on a specific situation or different contexts. In the early days of science, women were excluded from accessing universities. Black people, regardless of gender, were excluded from taking an official stand in significant discourses of science and politics for far longer [4]. This non-diversity of perspectives shaped scientific approaches, science fields and the production of knowledge in general [5] [6]. Today, when it comes to engineering education, the lack of diversity in the field still leads to the repetition of existing structures, contents, participants and potential outcomes, as Susanne Ihsen points out by referring to Luhmann's theory of social systems [7].

1.2 Two cultures: Bringing together the social and the technical

In 1959, British writer and scientist C.P. Snow gave a much discussed talk about the two cultures of the humanities and the (natural) sciences. The talk (and paper/book) states a lack of general education when it comes to science (at the U.K. at that time), as well as it criticizes the gap between the two cultures which, according to Snow, damages progress for society as a whole [8]. In our approach, two very unlike areas of expertise come together with gender studies and mechanical engineering. To establish a dialogue between them poses challenges to both sides. By no means are gender studies as well as mechanical engineering closed fields with a canonical body of knowledge and methods, but very generally speaking they do follow different paradigms that complicate communication: Whereas engineering design *constructs*, gender studies *deconstruct.* Engineering needs to standardize, generalize and make certain normative choices in the course of the development process in order to build reliable artefacts. Gender studies set out as a transdisciplinary endeavor crossing traditional fields of knowledge and deals with epistemological discourses and the social construction of science and scientific objects. Gender studies questions norms, concepts of normativity and generalized assumptions.

In the project 'GenderING', we employ gender studies as a means for reflection. We review existing lecture material, for example, for blind spots, for matters of in- and exclusion, for perspectives that have been left out. Therefore, we analyze the complexity and intersectional character of the category gender in its interwovenness with the content, structure, imagery and the shaping of technology. Technological development is always embedded within society – it co-evolves with society.

Technological artifacts are therefore never value-free, but have social and political impact [9]. Hence, we understand every technical system as a socio-technical one. This means that all steps of technological production socio-cultural and political questions matter.

Our aim is to enhance this perspective in engineering educators and students alike. This will not only lead to a broader and more inclusive education resulting in more inclusive technologies – it also prepares for work in global industries as well as in research institutions. Increasingly, research funding organizations ask for the integration of gender and diversity aspects into the agenda of research projects. For European Union research funding, for example, acknowledging the gender dimension marks excellent research.[4]

2 GENDER STUDIES MEETS CAR BODY DEVELOPMENT

2.1 The GenderING approach

In the project 'GenderING', aspects of intersectional gender studies are to be integrated exemplarily in the course "Introduction to Car Body Development". This module, which consists of a weekly lecture and an accompanying exercise course, familiarizes students with car development with a special focus on design engineering the car body. It provides an overview of construction methods, the use of materials, safety, ergonomics and production, production costs, etc. Additional talks are given by practitioners and car industry experts. The current format of the lectures is teacher-centered. Lecturers use examples in form of demonstration materials and visual aids. The exercise course is optional and gives student teams the opportunity to practice the expertise and knowledge gained in the lectures in test scenarios. The lectures cover topics such as requirements for car (body) development, packaging, car body composition and material, dimensioning, construction modes and production. Ideally, the module enables students to define, design and evaluate concepts for car body development according to given requirements.

The team of 'GenderING' consists of two researchers from gender studies in engineering und the two lecturers from mechanical engineering. One important step in interdisciplinary projects is to establish common ground. Engineering and gender studies both have developed their own academic cultures. Gender studies are rooted in the humanities and social sciences, where knowledge is mostly distributed in smaller seminars by reading and discussing texts. Engineering, in a traditional sense, is oriented toward problem-solving and teaches applied knowledge. Professional terminology and habitus in the disciplines differ as well. Thus, intensive work meetings are essential to the project. These serve to exchange basic concepts and terms and provide a deeper insight into each other's field. Such an interdisciplinary translation work is essential, since gender studies expertise cannot be realized merely in the form of guidelines or checklists for technological endeavors.

Parallel to the work meetings, the gender studies team reviewed the existing lecture material and identified connecting points for intersectional gender studies input. These connecting points were discussed with the engineering design team. This interlinkage is important, since the goal of the project is to interweave gender

[4] "The 7th Framework Programme strives to promote gender equality in scientific research, by facilitating the participation of women scientists and integrating the gender dimension into research content in all research areas."
http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1297 (11.03.2015)

expertise with the existing material rather than providing additional lectures or an add-on. Ideally, these newly integrated contents would also alter the structure of the existing module, leaving more space for an active reflection of the material by the students and shifting the focus from teacher-centered to student-centered teaching. At this point, the didactical restructuring has not been implemented.

In our approach we are aware, of course, that though still sparse, some concepts and guidelines for *gender in technology/engineering* already exist. The most prominent example is Stanford University's Gendered Innovations project,[5] which addresses all STEM disciplines. The section dealing with engineering largely draws on a German Fraunhofer Project called Discover Gender [10]. Although its underlying gender concept is quite complex, the project has been criticized for its lack of implementing this complexity in their discussion of concrete case studies [11]. Our approach is inspired by Ihsen's work [7] and the approach of "integrative gendering", established at the Leuphana Universität Lüneburg, Germany [12]. Furthermore, we take our own work as a basis, in particular, the GERD model [13] and the degendering approach to artifacts [14], which make gender studies methods available for computing science research and development.

2.2 Connecting points

In the review and discussion process of the 'GenderING project' we identified terms and topics that are central to the lecture material and that can also serve as an entry point for intersectional gender studies knowledge. To give an insight into our work processes, we list several relevant topics followed by questions that serve as means for reflection.

Norms

- Which norms are used, which have to be used, and who do these exclude?
- What are the context and the history of a specific norm?
- What is the role of a specific norm in international, intercultural settings?
- How can norms be changed or adapted in order to include, e.g., a variety of body types?

Image of the human

- To whom does the reference model of the design, development and evaluation explicitly or implicitly refer to?
- How can a more diverse, inclusive, realistic image of the human be employed?
- Who is placed at the center of research and development, who is at the margins?
- Are different bodily abilities considered?
- Which groups of people matter, e.g. factory workers, suppliers, traffic participants (also animals)?

Ergonomics and safety

- Whose body measurements are used, whose are left out and why?
- Which people and participants (animals) are not considered?
    - Crash test dummies, for example, were originally standardized to male and non-pregnant bodies. This demonstrates that one-dimensional or stereotypical assumptions about target groups can lead to dangers for

[5] http://genderedinnovations.stanford.edu/ (18.03.2015)

users, problems of acceptance or economic failures.[6]

- What are the test scenarios, and how do these relate to everyday usage?

Standardization

- Is the tension between standardization and plurality of living situations problematized or considered?
- What and whose knowledge informs the standards, generalizations and norms?

Production Processes

- How do the planning phases of the car body relate to its actual production?
- How are materials, methods and tools selected?
- Is there a concept of sustainability? And if so, which one (economic, environmental) and how are different groups of people affected by this?
- What are the working conditions in production like for the workers, nationally and internationally?

These topics are just examples of possible connecting points. What is important to note is that instead of providing students with fact-oriented knowledge, we aim at providing them with a framework for contextualizing, situating and reflecting upon engineering concepts and practices. This leads to the next point of reconceptualizing the learning and teaching objectives.

2.3 Learning and Teaching Objectives

Similar to the content-oriented connecting points between gender studies and engineering, we proposed objectives for the learning and teaching process. These objectives are inspired by qualifications that gender studies students acquire [15]. They mainly center around two basic topics:

1. Reflecting upon and broadening the engineer's own standpoint:
   Students and teachers learn to recognize their self-understanding and the limitations of their own perspectives. They are invited to take over new, alternative roles and learn about changing viewpoints.
2. Engineering in context:
   The lecture material as well as the resulting practices should be understood within their societal context and situatedness. Artefact production is something that is never value-free – technology is designed and built under specific historical and political conditions and by specific people.

Various further aims or possible outcomes of the project from these two:

Allowing a change in perspectives and questioning the given state of the field can open up spaces for the development of new, even non-conventional, technological solutions. Alternative models, the use of thought experiments, especially those including formerly marginalized positions, can lead to a renewal of the discipline. Another important point is to strengthen the responsibility for technological design and production every engineer should be aware of – not just for their immediate

[6] See the development of pregnant crash test dummies: http://genderedinnovations.stanford.edu/case-studies/crash.html and http://www.volvocars.com/uk/top/my_volvo/volvo-accessories/child-safety/pages/pregnant.aspx (18.03.2015).

environment but for different people and local and global contexts. Intersectional gender studies, furthermore, educate to work in a globalized world. Future engineers need to learn to be sensitive towards other cultures and to discuss and reflect upon their own background. Gender studies methods include the facilitation of interactive approaches, interdisciplinarity and target-group specific tailoring of products and procedures.

3 (FUTURE) CHALLENGES

Gender studies and mechanical engineering are not just two academic fields that differ in methodology, culture, and participants. They each enjoy very different positions in academia as well as in society at large. Not just in a country like Germany with its *Ingenieurskultur* (engineering culture), engineers holds a high social status. In contrast, gender studies is a rather marginalized discipline, in which positions are often unstable and contested in academia.

One effect of this difference in hierarchies is that gender studies experts are often required to prove the significance of their input when they are engaged in technological projects. This can even lead to circular reasoning: the in- and exclusions of technological production, for example, are not visible before the process has undergone an intersectional gender studies analysis. However, if gender studies experts have to prove the relevance of their research for engineering before they enter into alliances with technological fields, it is difficult to provide results. Thus, collaborations of gender studies and engineering need time, space and acceptance of and for the discipline.

In the project ‘GenderING’, integrating intersectional gender perspectives means additional work for the teachers, too. Furthermore, they have to revise their current thinking and need to get involved in unknown territory. It is noteworthy that so far, enriching the content of the car body development lectures is successful, but to alter the structure of the course is a challenge. To reach and train important educational goals such as reflection and awareness, however, a restructuring of the current format of the lecture from teacher-orientation towards student-orientation is necessary.

4 ACKNOWLEDGMENTS

The ‘GenderING’ project is funded by the program “Innovationsprgramm Gute Lehre” of the TU Braunschweig in the teach4TU project of the German federal ministry for education and research (bmbf), reference no. 01PL12043.

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