

## Chemistry

**Also relevant for: Chemistry Teaching, ecology**

Course: Chemistry

Group of courses: Mathematics, Natural Sciences

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## Course objectives:

Students should gain an overview of the significance of gender relations for the development of chemistry and for the way society deals with chemical products. They should learn to be critical about chemistry's claim to gender neutrality and should be enabled to understand gender analyses as "eye openers" for integrating chemistry into contexts of action in society.

## Teaching content/subject-specific gender studies content:

Gender studies in chemistry discuss interactions between gender relations and the development of chemistry. The focus is on the question of how gender relations take effect on knowledge and the products manufactured in chemistry as well as on the research and development directions chemistry takes. Looking at the category of gender focuses attention to the societal context in which chemical investigations and developments take place, and calls into question the self-image of chemistry as a value-free and objective science that is still particularly prevalent in the scientific community (Weller 1995, Weller 2006, Weller 2012).

In this context, chemistry has a peculiarity: on the one hand, the gender ratio in chemistry study courses is almost equal (see below); on the other hand, there are – unlike in other natural sciences such as biology – hardly any substantial analyses available that show how and with what results gender is implemented in research topics, methods and concepts of the discipline. Moreover, the very few available analyses refer more to sub disciplines of chemistry, such as physical chemistry and especially environmental chemistry (Bauer 2010). Chemistry-related environmental issues refer to the societal use of chemicals as important chemical products and draw attention to the importance of gender relations for chemical policy and management, i.e. how chemical findings are applied more than on basic chemical research.

Although a systematic approach to gender research in chemistry is currently not yet to be expected, the following studies and findings nevertheless provide exemplary indications of the significance of gender aspects. In line with Harding's distinction, different approaches are used, which can be divided into "Women in Science (Chemistry)", "Science of Gender" and "Gender in Science (Chemistry)" (Weller 2006, Weller 2012).

### Women in Chemistry:

The analysis of the situation of women in chemistry is in the foreground, focusing on:

Analyses of women's participation in the various fields and hierarchy levels of chemistry from the perspective of achieving equal opportunities. One of the first detailed studies on women's situation in chemistry at university and professional levels was carried out in the late 1980s by Roloff (1989). Today, a wide range of data on this issue is available showing a consistent discrepancy between students and professionals/academics: According to the Federal Statistical Office, in the years 2016/2017 the proportion of female students was just under 45 %, when all chemistry courses, including biochemistry and food chemistry, which have an above-average proportion of women, are considered together. In contrast, the share of female chemistry professors in Germany was only 14.6 % in 2015 (GDCh 2016). The chemical industry also has a large share of men, while at European level, their share was 71.4 % in 2016 (at executive board level) and 90 % (at management level) (cf. Hemmati/Bach 2017, p. 18). Studies and case examples of the link between the culture of chemistry

and the habitus of chemists suggest possible explanations for this situation. They have established, for example, that the image of a "successful chemist" within the discourses of chemistry is implicitly associated with practical skills and intuition, which are naturalised and coded as male in this context (Nägele 1998). A recent analysis of the career descriptions of chemists in a chemical journal confirms these findings. It suggests that successful chemists are constructed as gender-neutral, whereas career descriptions are implicitly based on male gender constructions (Pascher-Kirsch/Jansen 2014).

Studies that focus on identifying previously "invisible" women in natural sciences and their contribution to the development of chemistry, predominantly from a historical-biographical perspective. The focus is on the identification of female chemists who have not (or not adequately) been acknowledged by historiography so far. Bauer (2010) gives an overview of the very few women who have made themselves a name in the history of chemistry, among them Clara Immerwahr, who has been honoured with a biography.

In this context, it is important to shed light on female chemists as "unknown helpers", who took on important tasks in the implementation of experiments, for example, but have previously been neglected or undervalued by historical research (Löchel/Weller 1995, Bauer 2010).

Women's less direct contributions to the development of chemistry, particularly in multiplying and disseminating theoretical and experimental discourses, i.e. didactical work. Although these women did not directly influence the development of chemistry, they played a key role in training and promoting chemical skills and thus indirectly in the development of the subject (see e.g., Szász 1997, Wiemeler 2001).

#### **Science of Gender:**

This gender analysis level deals with the question of the extent to which chemical knowledge influences gender construction processes.

For example, in thermodynamics, Heinsohn has highlighted distinct connections between the scientific controversy over atomistic-mechanistic and energetic understandings of nature and the discourse on women's access to universities (Heinsohn 2005). Heinsohn has pointed out that the rejection of women studying at universities around 1900 was founded on "physicochemical" arguments, such as that intellectual work was harmful to women because of the higher energy consumption of reproduction, claiming that studying was a waste of energy for women.

Another study has examined the (re)production of gender and gender differences in chemistry lessons and has analysed how chemistry has been constructed as a "male" science in the classroom. For this purpose, face-to-face interactions as well as educational material and chemistry photo stories (i.e. documentations of experiments in class) have been examined and conclusions for new concepts of chemistry in class have been drawn (Prechtel 2005).

#### **Gender in Chemistry:**

The focus is on the question of how gender is inscribed in the way problems are constructed, concepts are developed and chemical products are used.

This gender analysis level addresses the question of how approaches and problem solutions in chemistry deal with the gender-coded areas of production and consumption and how these areas are perceived. Scholars have studied examples of societal attitudes to materials regarding the influential

relationship between the reproduction, private consumption and in this context the use of materials an area conceived of as "female" and the development, design and manufacture of materials an area conceived as "male" (Weller 1995, Weller 2004). The findings indicate that there is significantly less knowledge on the use of materials and their behaviour embedded in everyday products than on their manufacture. This is due to the problem of the restricted transferability of knowledge on the characteristics of materials, gained in chemical experiments under laboratory conditions, to the behaviour of these materials in the real world. In chemistry's attitude to materials, use demarcates a knowledge gap, thus establishing a decontextualised view of problems, which frequently neglects the social context of dealing with materials. This gap can also be understood as an expression of gender hierarchies, constituting and simultaneously devaluing a female-coded area of private consumption in which the use and application of products and the materials that form them take place (Weller 1995, Weller 2004, Weller 2006).

In recent years, gender analyses in the context of chemicals policy have become increasingly important against the background of gender mainstreaming. In this context, works on policy and safety of chemicals and their consequences for gender relations (Buchholz 2006) are still of relevance today. They have shown that regulations on chemical safety and new developments on chemicals policy have barely looked into the question of differences between the genders in exposure and the consequences of contact with harmful materials, for example in setting maximum limits. These debates and studies indicate problematical basic assumptions about an "average person", who is implicitly conceived as male, healthy, young, employed and not pregnant. This means that the life situations of other groups, e.g. children, women or unhealthy males, are not taken into account adequately. It also means that exposure situations that are not related to the occupational context and work sphere are only marginally included in the evaluation of the risks of substances. Recent studies have confirmed that gender differences with regard to exposure and sensitivity to chemicals and their health effects have not been sufficiently considered and investigated to date (Hemmati/Bach 2017). On the other hand, significantly more data and insights, e.g. on gender differences in exposure to or the health effects of various chemicals, such as heavy metals or persistent organic pollutants (POPs) (UNDP 2011) have been available. Possible reasons for these differences and the roles physiological processes, patterns of behaviour or the perception of health risks caused by chemicals and the acceptance of preventive and safety measures play in this context, are subject for further research.

## **Integration of gender studies content into the curriculum:**

The following possibilities are conceivable. These proposals bear in mind that chemistry degrees have not previously addressed the significance of gender, and therefore offer initial "anchor points".

1. "Gender studies in chemistry" in optional subjects such as "Philosophy of natural science" or "History of natural science", focusing in particular on the significance of gender relations for the development of chemical knowledge and on women's contributions to chemistry from a historical-biographical perspective.
2. "Gender and chemistry" as part of seminars/lectures dealing with the subject areas of toxicology and occupational safety. The focus of this module should be on gender aspects of chemicals policy and safety, and on androcentric basic assumptions of evaluation and their consequences for gender relations.
3. "Gender relations in chemistry" as part of introductory seminars/lectures on the professional fields and practice of chemists. The focus should be on discussing gender inequality with regard to the aim of equal opportunities in chemistry.
4. "Gender studies in chemistry" as part of courses on gender studies in science and technology,

enquiring into what chemistry has in common with other scientific and technical disciplines, and what sets it apart.

## Degree Stage:

The above content should be integrated into Bachelor's degrees, particularly in the fifth and sixth semester. It should ideally be dealt with in more detail in the subsequent Master's degree courses.

## Basic Literature/Recommended Reading:

- Bauer, Robin (2010): Chemie: Das Geschlecht des Labors – Geschlechterverhältnisse und –vorstellungen in chemischen Verbindungen und Reaktionen. In: Ruth Becker, Beate Kortendiek (Hrsg.): Handbuch Frauen- und Geschlechterforschung. 3. erweiterte und durchgesehene Auflage. VS Verlag für Sozialwissenschaften: Wiesbaden.
- Buchholz, Kathrin (2006): Genderrelevanz und Genderaspekte von Chemikalien. In: Ebeling, Kirsten Smilla, Sigrid Schmitz (Hrsg.): Geschlechterforschung und Naturwissenschaften. VS Verlag für Sozialwissenschaften: Wiesbaden.
- GDCh (Gesellschaft Deutscher Chemiker) (2016): Chemiestudiengänge Deutschland 2016.
- Heinsohn, Dorit (2005): Physikalisches Wissen im Geschlechterdiskurs. Thermodynamik und Frauenstudium um 1900. Frankfurt/New York: Frankfurt am Main.
- Hemmati, Minu, Anna Bach (2017): Gender & Chemicals. Questions, Issues and Possible Entry Points. Berlin: MSP Institute.
- Löchel, Elfriede, Ines Weller (1985): Worin unterscheidet sich ein Naturwissenschaftler von einer Naturwissenschaftlerin? Er beherrscht die Natur, sie verstößt gegen „ihre Natur“. In: Bremer Frauenwoche (Hrsg.): Leben und Technologie. Bremen.
- Nägele, Barbara (1998): Von 'Mädchen' und 'Kollegen'. Zum Geschlechterverhältnis am Fachbereich Chemie. NUT-Frauen in Naturwissenschaft und Technik e.V. Schriftenreihe, Band 6, Mössingen-Talheim.
- Pascher-Kirsch, Ute, Katrin Jansen (2014): Chemiker machen Karriere. Und Chemikerinnen? Eine Annäherung an die Karrierebilder im Fachdiskurs der Chemie. Gender. Zeitschrift für Geschlecht, Kultur und Gesellschaft 3/2014.
- Prectl, Markus (2005): ‚Doing Gender‘ im Chemieunterricht. Zum Problem der Konstruktion von Geschlechterdifferenz – Analyse, Reflexion und mögliche Konsequenzen für die Lehre von Chemie. Köln. Dissertation.
- Roloff, Christine (1989): Von der Schmiegsamkeit zur Einmischung. Professionalisierung der Chemikerinnen und Informatikerinnen. Centaurus-Verlagsgesellschaft Pfaffenweiler.
- Szász, Ildikó (1997): Chemie für die Dame: Fachbücher für das 'Schöne Geschlecht' vom 16. bis 19. Jahrhundert. Ulrike Helmer Verlag: Königstein/Taunus.
- United Nations Development Programme (UNDP) (2011): Chemicals and Gender. Energy & Environment Practice. Gender Mainstreaming Guidance Service. Chemicals Management. UNDP Environment and Energy Group.
- Weller, Ines (1995): Zur Diskussion der Stoffe und Stoffströme in der Chemie(-politik): erster Versuch einer feministischen Kritik. In: Irmgard Schultz, Ines Weller (Hrsg.): Gender & Environment: Ökologie und die Gestaltungsmacht der Frauen. IKO-Verlag für Interkulturelle Kommunikation: Frankfurt/Main.
- Weller, Ines (2004): Nachhaltigkeit und Gender: Neue Perspektiven für die Gestaltung und Nutzung von Produkten. Oekom Verlag, München.

- Weller, Ines (2006): Geschlechterforschung in der Chemie: Spurensuche in der Welt der Stoffe. In: Ebeling, Kirsten Smilla, Sigrid Schmitz (Hrsg.): Geschlechterforschung und Naturwissenschaften. VS Verlag für Sozialwissenschaften: Wiesbaden.
- Weller, Ines (2012): Geschlechterverhältnisse der Chemie in Deutschland: Un/Gleichheiten, Paradoxien, Leerstellen. Blätter für Technikgeschichte, 74 (12).
- Wiemeler, Mirjam (2001): Wissenschaftshistorische Forschung über Chemikerinnen der ersten Hälfte des 20. Jahrhunderts. In: Helene Götschel, Hans Daduna (Hg.): PerspektivenWechsel: Frauen- und Geschlechterforschung zu Mathematik und Naturwissenschaften. Talheimer Verlag: Mössingen-Talheim.