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Innovation through Gender in Computing [INTeGER]

Research context: why gender matters

Computer science is a fast-moving and innovation-intense field, delivering research that is fundamental to the development of new technologies and one of the main vehicles of the 4th industrial revolution already under way[1]. Being part of the broader STEM disciplines, it is also under pressure to contribute to responding to the grand societal challenges, as exemplified by the Horizon 2020 research policy and funding framework of the European Union. Computer science – and ICT more generally – are also called to reflect on the way they undertake research and development activities and take ethical considerations into account, as presented under the banner of "responsible research and innovation"[2]. Simultaneously, ever since the 1970s feminist scholars have been pointing out that scientific knowledge is not gender neutral but is deeply related to the power dynamics that permeate societies in general, and thus cannot be properly advanced as long as sciences do not account for whose perspectives are dominant in their own epistemologies and findings[3]. Similarly, contemporary debates on women's position in ICT and computing has exposed the still prevalent gender bias in the field and the industry, prompting major companies (such as Google and Intel) to invest in equality-minded projects and to change their hiring procedures, and political bodies such as European Commission to highlight the importance of empowering women in digital research and innovation as one of their policy goals[4].

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[1] Klaus Schwab (2016): The Fourth Industrial Revolution: what it means, how to respond. Online: https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

[2] Marina Jirotka, Barbara Grimpe, Bernd Stahl, Grace Eden, Mark Hartswood (2017): 'Responsible Research and Innovation in the Digital Age', in *Communications of the ACM,* Vol. 60 No. 5, Pages 62-68, DOI: 10.1145/3064940. Online: https://cacm.acm.org/magazines/2017/5/216330-responsible-research-and-innovation-in-the-digital-age/fulltext

[3] See, for example, the work of Sandra Harding: *The Science Question in Feminism*, 1986; *Whose Science? Whose Knowledge? Thinking from Women's Lives*, 1991; *Science and Social Inequality: Feminist and Postcolonial Issues*, 2006.

[4] See European Commission's website: https://ec.europa.eu/digital-single-market/en/women-ict

Case: Gendered computer vision

In 1997, Danah Boyd – currently principal researcher at Microsoft Research, a research assistant professor at New York University, and a fellow at Harvard's Berkman Center – discovered that she and her fellow female users of 'Cave Automatic Virtual Environment' (CAVE) experienced higher degrees of motion sickness (or what in military research is called 'simulator sickness') than her male peers. Taking this observation as a hunch, she pursued further research and discovered that 3D virtual reality environments rely on recreating the motion-parallax – one of the cues for depth perception that the human brain employs. She also discovered that this happened to be the cue that biological males prefer, while biological females prioritize a different kind of cue – shape-from-shading. According to Boyd, this might explain the higher rate of 'simulation sickness' among women, and provides a basis for a call for more research into whether hormone-based biological differences – and not just pixel persistence and latency rates – are the root cause of different experiences of immersive virtual reality environments. With virtual reality developers continually presenting new technologies, such as Oculus Rift, the question of how these technologies are developed and who will be able to use them becomes ever more important.

Source: https://qz.com/192874/is-the-oculus-rift-designed-to-be-sexist *and original research article:* http://www.danah.org/papers/sexvision.pdf

One of the main arguments in feminist science studies and science and technology studies in general is that gender works both as a category of knowledge and as one of the dimensions along which knowledge is produced. In other words, gender is as much an object of knowledge itself as it is a lens through which other knowledge claims can be evaluated. This latter methodological aspect of gender is highlighted in one of the most successful and innovative gender mainstreaming projects in STEM – the *Gendered Innovations* project led by Londa Schiebinger at Stanford University.

Case: Gendered Innovations

Gendered Innovations harness the creative power of sex and gender analysis for innovation and discovery. It develops practical methods of sex and gender analysis for scientists and engineers; and provides case studies as concrete illustrations of how sex and gender analysis leads to innovation. It relies on the premise that when it comes to gender equality, the universities not only need to 'fix the numbers' and 'fix the institutions' but also 'fix the knowledge': that is, add a 'gender dimension' to research and innovation and in this way, stimulate excellence in science and technology by integrating sex and gender analysis into research. Gendered Innovations is built on the idea that at every step of research and development gender and sex should be taken into account, i.e. from formulating questions, to conducting research/designing a specific innovation, to applications and testing. In this sense, Gendered Innovations is a methodological addition to the specific disciplinary methods already existing in different fields.

Source: http://genderedinnovations.stanford.edu

While Gendered Innovations focuses extensively on engineering, medicine, environmental and natural sciences, the field of computer science would benefit from a further inclusion of gender as a methodological and epistemological dimension in its research and development activities.

Gender and innovation in computing at the University of Kassel

Taking Gendered Innovations as a case of best practice in producing innovative, cutting edge and highly socially relevant research in STEM fields, the INTeGER project seeks to establish and support research on gender and innovation in computing at the University of Kassel. Thus, the project focuses on interrogating the role that gender plays in producing innovation in the field of computing. While

the question of gender bias in computing as well as computational innovations is not new (examples abound in research spanning from algorithms and machine learning[5], to speech recognition technologies[6] and so on), and while researchers and practitioners in the field have been looking into how ICT design can take feminist concerns into account[7], more interdisciplinary research that bridges gender studies, feminist science and technology studies and computer science is needed. It is also crucial to look at how exactly innovation in computer science is done, and how the process of innovation can be improved by introducing gender as a methodological lens.

Case: Gender Extended Research and Development Model – GERD
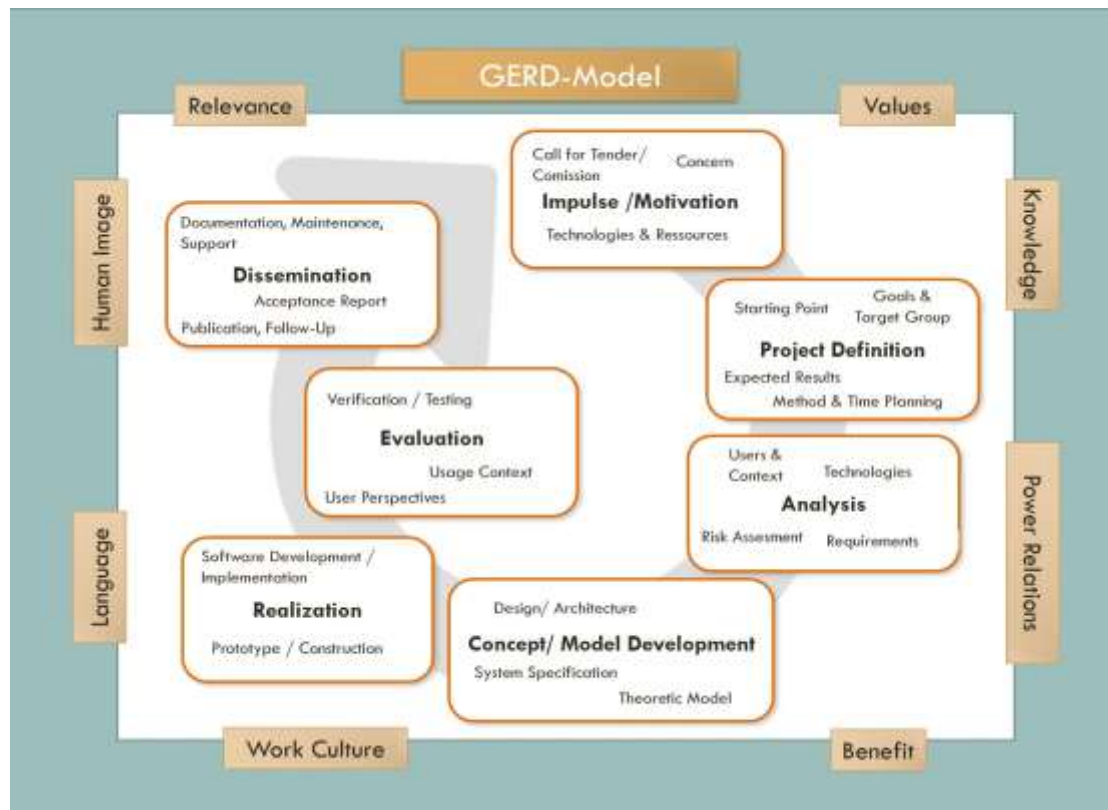
The GERD model, developed by Claude Draude, Susanne Maaß and Kamila Wajda, integrates gender and diversity aspects into research and product development cycles in computer science. Its aim is to connect these aspects rather seamlessly into work practices of developers by building on existing procedure models from software engineering while translating concepts from gender studies to the field of computing.

Source: http://www.informatik.uni-bremen.de/soteg/gerd/?action=modell and research article[8]

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[5] For example, Aylin Caliskan, Joanna J. Bryson, Arvind Narayanan (2017), 'Semantics derived automatically from language corpora contain human-like biases', in *Science* 14 Apr 2017: Vol. 356, Issue 6334, pp. 183-186.
[6] See, for instance, Rachael Tatman's research on Google speech recognition in 2016: https://makingnoiseandhearingthings.com/2016/07/12/googles-speech-recognition-has-a-gender-bias/
[7] For instance: Corinna Bath (2014), 'Searching for Methodology. Feminist Technology Design in Computer Science', in Waltraud Ernst and Ilona Horwath (eds.), *Gender in Science and Technology: Interdisciplinary Approaches*, Bielefeld: Transcript Verlag, p. 57-78. Online: http://www.oapen.org/search?identifier=463250
[8] Claude Draude, Susanne Maaß and Kamila Wajda, 'Gender-/Diversity-Aspekte in der Informatikforschung: Das GERD-Modell', in Nicola Marsden and Ute Kempf (eds.), *Gender-UseIT. HCI, Usability and UX unter Gendergesichtspunkten*, Oldenburg: De Gruyter, pp. 67–77.

INTeGER is designed to develop along two directions (or a combination of both):

- Innovations in computer science and its gendered aspects: what is the process of innovation in computing, what is understood as innovation in computing, and how this idea and process is affected by gender?
- Gendered methodologies in computing: what are the methods and methodologies that are most prominent in computer sciences and how they interlink with intersectional notions of gender?

The project addresses the following questions: How does innovation in computing happen and what are the gendered elements of it? What kind of paradigm shifts are needed to increase gender-sensitivity in computing? How does lack of this sensitivity influence the end results of research and its possible applications?

INTeGER is highly interdisciplinary and integrates knowledge from computer science, science and technology studies, and gender studies.

Relevance and contribution to strategic goals of the University of Kassel

The INTeGER project contributes to two of the key fields of expertise of the university[9], namely social useful IT-Design and culture and gender research. Interdisciplinary in nature, the project helps to create synergy and dialogue between engineering/computer science and social science faculties and research communities. The strong methodological aspect and the social relevance of this research seeks to strengthen the position of the university as a place for innovative research, and thus contribute to the strategic goals of promoting interdisciplinarity and international visibility with the unique feature of gender research in STEM.

By establishing the work group "Gender/Diversity in Informatics Systems", University of Kassel already has taken an important step towards the implementation of gender research in STEM disciplines. Furthermore, various research-oriented activities, initiated by the Frauen- und Gleichstellungsbüro like the 2014 lecture series "GENDERforschung in die MINT-Fächer", ongoing discussion and workshop series "Vielfalt mitdenken! Gender und Diversity im MINT-Bereich" are supporting interdisciplinary cooperation structures in the STEM disciplines of the University of Kassel.

INTeGER is funded by the University of Kassel. Project duration is three years, starting February 2018.

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[9] As outlined here: http://www.uni-kassel.de/uni/internationales/english-version/research.html