Gender Research and IT Construction: Concepts for a Challenging Partnership

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"We, the representatives of the peoples of the world, […] declare our common desire and commitment to build a people-centred, inclusive and development-oriented Information Society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life, premised on the purposes and principles of the Charter of the United Nations and respecting fully and upholding the Universal Declaration of Human Rights."

This Declaration of Principles for Information Society was made during the UN World Summit of the Information Society in Geneva 2003[1].

Current transformations towards the Information Society are affecting professional and private lives, individual and societal interactions, economic and educational directions and technological developments. Or, to put it the other way around: New technologies and in particular information and communication technologies offer a multitude of opportunities for transformations in the mentioned (and many more) fields. To emphasize this close connection the EU used the term 'Information Society Technology' (IST) in their 6th Framework and put forth the "IST Vision: anywhere anytime natural access to IST services for all"[2].

1. Information Society Technology – New Opportunities for Everyone?

Notwithstanding the ideological goals of creating an 'inclusive' Information Society for 'everyone', the chances offered by Information Society are unequally distributed, e.g. by country, class, ethnicity – and by gender, the very aspect this book will focus on. Equal opportunity is the agreed-upon goal of WSIS participants. With respect to gender, the EU set out to accomplish equal opportunity by its so-called 'gender mainstreaming' strategy. This means that political actors need to assess the potential consequences of any decision for women and men, including those concerning implementation strategies for Information Society Technologies.

Access to and ability to use IST are the prerequisites for participation in many of today's social, cultural, political or economic activities. Lack of opportunity as well as individual abstinence, both have the same effects: being a 'non-user' of computers or the Internet means to be excluded from large parts of society, so inequalities in access and use are highly problematic. On top of

1 WSIS Declaration of Principles http://www.itu.int/wsis/docs/geneva/official/dop.html

2 http://cordis.europa.eu/ist/activities/activities.htm

this, involvement in IST design is a highly prestigious activity. Information technology business offers positions of power and good incomes for those with the appropriate (technical) education and enough self-confidence.

With respect to sex we currently find inequalities of various kinds. On a global scale the kind and quantity of IST use still differs widely. Women's access to Internet technology is generally lower than men's, and this is true not only for the South but also for the North (except for the US): According to the SIGIS report, in January 2002 women in France, Germany, UK, Norway, Denmark and Sweden accounted for about 40-45% of all Internet users, with women in Italy and Spain just below 40% (Stewart 2002, 5). The overview also lists research results which show that women use the Internet less often than men and that the individual Internet sessions by men take longer than women's (ibid.). In 2006 the percentage of Internet users among men (65.4%) was still higher than among women (51.5%) in Germany (TNS infratest 2006). Especially among people with low educational background the gender gap is much more significant.

By far the largest gender gap can be observed in IT professions. In several European countries like Germany, UK, the Netherlands, Belgium, Italy, Denmark, Austria, Finland, Sweden and France, the numbers of women researchers in engineering and technology were below 20% of total researchers in 1999, some of them even below 10% with an EU average of 12% (Stewart 2002, 18). In all major OECD countries female graduates in computing are (often far) less than 50 % of all graduates (OECD 2006). In Germany in 2004 less than 17% of all incoming students and about 16% of the graduates in the field of computing science were women, these numbers are even lower in Denmark, the Netherlands and Belgium. Countries like the UK, Italy and France have a slightly higher percentage of around 22% female graduates amongst computing scientists, whereas Finland and Sweden have the highest percentage with over 40%.

Gender research with respect to the field of computing has been done for quite some time (for an early overview see Richelmann, Schmidt 1989). The most important starting point was the perceptible gender gap in computing as described above. Gender research was done from two perspectives: from 'outside' – social scientists studied science and technology disciplines and the people involved in them; and from 'inside' – women in science and technology reflected on disciplinary cultures and on their own biographies. Authors from both perspectives present their work in this book.

The book is based on contributions to the International Symposium 'GIST – Gender Perspectives Increasing Diversity for Information Society Technology' that took place in Bremen, Germany, in June 2004[3] (N. et al. 2004). The symposium attracted researchers from around the world and from many disciplines, sharing the goal of applying gender research to the IT sector and of supporting women's projects with adequate technology. Gender perspectives do increase the diversity in thinking about technology, its use and its users. The authors in this book will present new starting points for

[3] see www.e-gist.net

criticism of technology and examples for ways to actively influence IST development.

Our aim is to show that by explicitly introducing gender perspectives into IST design we have a chance not only to bridge the digital divide but also to improve IST and its construction processes in general. Today software designed for a female audience sometimes is based on very simple stereotypes that picture girls and women in traditional roles and as disinterested, even antipathetic and un-knowledgeable users of technology. We hope instead that software construction informed by gender studies will support the deconstruction and transformation of existing assumptions and structures as far as gender relations are concerned and will lead to software and software design processes that will empower men *and* women.

The authors' disciplinary backgrounds are diverse, ranging from computing science, math and biology to philosophy and theory of science, but also scholars with a background in sociology, psychology, international management and the arts are represented**.** They bring together perspectives from computing science and from gender studies and they cover epistemological, technical, educational and socio-political questions. With these topics we address a variety of readers: *computing science researchers* who work on socially oriented software engineering methods or innovative technologies with an interest in encountering new perspectives on requirements engineering and paths of innovation; *software designers* interested in constructive impulses that cause them to question their own images and assumptions about the user communities they serve; *gender researchers* with an interest in examples of how to apply gender research to the fields of IST development; *computing scientists* applying for project funds as well as *policy makers* with an interest in gender mainstreaming criteria that are relevant in technology design projects; and *teachers and trainers in technology* with an interest in gender-sensitive teaching practices.

The remainder of this chapter will start by defining three gender research approaches to Information Society Technology: the liberal tradition, standpoint theory and post-structuralism. In section 3 we will describe how this fits with the traditional concepts of computing science and recent trends to further open the discipline for social considerations. In section 4, we will introduce the various parts and chapters of this book.

2. Gender Studies Approaches to Information Society Technology

Although all authors in this book relate to gender studies in some way or other, their perspectives vary as much as their disciplinary backgrounds. Indeed, gender studies itself is a multi- and interdisciplinary field of research, the commonality amongst gender studies researchers in general and specifically in this book is caused by the kind of questions asked. The critical perspective is common with attention being paid to power structures and relations (making visible who benefits and what is invisible and/or undervalued) on the one hand and to studying and challenging existing norms, to show where changes and transformations are possible on the other. Similarly, imagining 'the' gender (sensitive) perspective or one single

methodology is inherently problematic. As many gender researchers have shown, each set of standards, categorization or instrument brings its own blindness, obscures some things at the same time as it highlights others (see Bowker, Star 2000; Maass, Rommes this volume; Björkman et al. this volume). This is especially problematic in a field of research that intends to study what is being left unstudied or invisible.

Concepts and questions used in gender analyses have shifted over time as research topics and interests changed, as theoretical and political positions shifted and as different explanations for the gender gap led to different policy and research frameworks. We will introduce three perspectives, epistemologies, or research frameworks; each employing different sets of questions and each presenting different sets of explanations for the relative exclusion of women from the Information Society. These perspectives have also led to different kinds of measures to narrow the gender gap, some of which have been adopted by policy makers or companies. In each chapter of this book, traces of, points of inspiration or references to these traditions can be found. We will present the liberal tradition, standpoint theory and post-structuralism (for similar categorizations see e.g. Wajcman 2004).

In the **liberal tradition**, which is the research framework most commonly found amongst policy-makers, women and men are regarded as being equal. However, since women have been placed in a disadvantaged position, they need support in overcoming material and other barriers that exclude them from the Information Society. So, much policy for including women in the Information Society is based on a deficit, resource or discrimination model of inclusion, meaning that women need economic, social and knowledge support to overcome their exclusion and they need support against gender discrimination at work or while pursuing an education. Within this tradition, it is more common to write about men and women, rather than about masculinities and femininities or individual men's and women's experiences. Indeed, much statistical research can also be categorized under this tradition.

Gender researchers within this tradition have made women and their work visible in the history of the development of IST, showing that women have worked in IT professions since its conception and that there is no inherent difference between men and women that disqualifies women from being competent IST designers and users (Oost 1998; Schelhowe 1991). Others within this research framework have studied discriminatory practices. Oldenziel (1997), Cockburn (1985) and Hacker (1989), for instance, have shown how types of legislations and selection criteria at work have effectively blocked women from entering technological fields. Sutton (1991) and Rasmussen and Håpnes (1991) have shown how discriminatory practices by teachers and peers at schools and universities make it harder for girls and young women to gain the required skills and knowledge. And several studies have shown that access to computers and the Internet at home and for leisure activities is more easily available for boys and men, who have more material, cultural and social resources needed for getting access (Haddon 1992; Håpnes, Sørensen 1995; Bimber 2000; Stanley 2003) and who are not (sexually) harassed on the Internet (Cherny, Weise, 1996). With the help of

the ‘script’-concept, questions about whose work, skills, ambitions and needs are supported by technology can be posed, showing how not only in culture but also in technology itself exclusion mechanisms can be incorporated or maintained (Green et al. 1993; Hofmann 1999; Rommes et al. 1999; Rommes 2002a; Bardini, Horvath 1995).

The liberal feminist tradition and especially policies based on this research framework have been criticized for unconsciously replicating the male norm in society: if all barriers are removed, women should become as active and in the same way active as men. Although material preconditions and resources are indeed vital for the inclusion of many (but certainly not all) women, the relevance and the pleasure of IT use for individual women need to be clear before strategies based on these models may work, which brings us to the second research and policy framework.

The main thesis of the **standpoint theory** is that women and ‘femininities’ (e.g. female connotated characteristics, skills and values) need to be revalued and regarded as equally or even higher valued than male connotated values and skills. Hence, many but not all researchers in this tradition assume that men and women are fundamentally different, either because of biological reasons or by socialization. According to this tradition, both technologies themselves and the cultures surrounding them are not adjusted to ‘feminine’ requirements, such as relevant content, utilitarian rather then fun functionalities or education and training based on ‘feminine’ learning styles. By making IST more relevant for women, women will automatically find it more attractive and may even informally learn the skills they need to include themselves in the Information Society. Hence, inclusion initiatives based on this research framework can be described as following the ‘rational non-use model’, as they assume that women’s lack of interest for IST is the result of rational choices by women, and inclusion is achieved by changing IST, rather than by requiring women to change. This policy framework is presently common amongst private and commercial companies and inclusion initiatives whose aim is, amongst others, to create a larger market by designing more diversified games, software and other products and targeting women as buyers or consumers of IST. Presently, this framework is also common amongst managers of companies who want to attract and retain women in the IT industry in order to have employees with better communicative or social skills, or who, as they are women, “know their female consumers better”. Gender studies scholars have criticized this assumption extensively for essentializing ‘women’.

Nowadays, among researchers within this tradition it is more common not to write about ‘women’, but rather about e.g. ‘people with feminine connotated interests’, as masculine and feminine connotated preferences, skills and characteristics can be found amongst both men and women. Indeed, several researchers have shown that introducing more women as designers or programmers does not necessarily result in products better geared towards women (Sørensen 1992; Rommes 2002b), nor that female IT professionals are more communicative (Faulkner 2006). Rather, design processes are needed in which the designer-standpoint and its commonalities and

differences with user-standpoints are made explicit, independent of who the designers and users are. Moreover, an often-heard phrase within this tradition is that technologies need to be attractive for a wider diversity of users, including those with feminine connotated interests, values or characteristics.

The main disadvantage of strategies based on the standpoint epistemology, especially if 'women' and 'feminine connotated interests' are regarded as the same, is that by working with these stereotypes they are being reinforced. By designing for so-called 'female values' (e.g. 'simple' interfaces or products aimed to teach girls to become relationship- and fashion-oriented women) we reinforce existing stereotypes and produce gendered subjects (Cassell, Jenkins 1998). This criticism applies equally to such optimistic accounts as those followed by cyberfeminists who point at the great potential of IST to improve women's lives because of its communicative potential, but who reinforce dualist gender accounts at the same time. The third research framework tries to find a way out of this stereotypical, dichotomous way of thinking by arguing that both IST and conceptions of gender need to change.

By far the most researchers within gender and IST studies nowadays identify themselves as working in the **post-structuralist** research framework. This tradition was inspired by the cultural turn in gender and technology research in the 90s and led to more interest in how identities or gendered subjectivities are shaped and how language, representations and images influence identity formations. Researchers within this framework refuse 'grand theories' about men/women and masculinities/femininities, as these theories themselves may help in creating and reproducing the symbolic link between masculinity and IT which makes IT a 'gender inauthentic' pursuit for many (but certainly not all) women (see for this argument e.g. Gansmo et al. 2003). Policy makers who follow post-structuralist lines of argument for explaining the gender gap in IST can be seen to follow the image model: they aim to disconnect the symbolic link between technologies and masculinities that is held responsible for the gender gap. To change these images, post-structuralists study the constructed nature of gender, technology and their relations. Both gender and IT are considered to be co-constructed, meaning that they mutually shape each other: masculinity is a defining characteristic of what technology is and 'being fascinated by technologies' is a defining characteristic of dominant masculinities in society.

Consequently, gender researchers within this tradition try to symbolically 'deconstruct' and redefine both 'femininity' and 'IT', showing how instable these categories are. This is done, for example, byanalyzing the many individual experiences that oppose gender and technology dichotomies or by retracing the semiotic or historical roots of the categories to show how they are the result of contingencies (like e.g. Oldenziel (1999) did with the category 'technology').

Computing science like many other technology fields is about analyzing existing worlds and building artifacts on the basis of these analyses. Gender researchers following a post-structuralist framework inquire: what values are present in society and inscribed in technology? With what kinds of assumptions and values about technology, users and the society do

designers work? Whose values and experiences are represented and what dichotomies and stereotypes are repeated in technologies and technological cultures? As argued before, gender researchers are, because of their multi-disciplinary background and simultaneous insider/outsider position, well situated to pose these kinds of questions about (hidden) norms (see also Björkman et al., this volume).

Indeed, several feminist scholars have been questioning the 'norm'al. Schelhowe (2004, 2005), for instance, discusses how computing science itself has been seen and has developed as an academic discipline. She questions the "normality" of seeing computing science as a kind of mathematics or as an engineering discipline, both disciplines with a strong male connotation, and she shows that it could have been otherwise. Similarly, Turkle and Papert (1990) have made visible the paradigms and domination of masculine connotated values in the teaching of computing science whereas Kvande and Faulkner have shown the persistence and dominance of masculine norms within engineering organizations (Faulkner 2000a; Kvande, Rasmussen 1994; Kvande 1999). Researchers have shown how some representations and some values rather than others became incorporated in technologies (Oost 2000; Faulkner 2000b). By studying how the at times hidden norms in education, programming practices and technologies have become dominant, alternatives can be suggested.

For policy-makers and designers, the realization that men and women fall into more than two categories means that there is no single strategy that will work to include 'all women'. Instead of aiming at standardized large systems, designers need to pay attention to local, contextualized knowledge and they need to be aware of the translations that are necessary to move from one context, location and set of knowledge to another (see e.g. Suchman 1994). Rather than encouraging designers to take into account potential users' different access to resources or to turn attention to feminine connotated values, gender researchers within the post-structuralist tradition encourage designers to pay attention to their specific users, to choose adequate design methodologies and to attempt to dissolve the boundaries between designers and users (Sørensen et al., forthcoming; Rommes 2006).

Gender researchers within the post-structuralist framework are mainly interested in the question: what gendered subjects are being (re)produced in work situations, through (in)formal teaching situations or by becoming a user or a designer of technologies? One method of studying this is to analyze biographies of women or female engineers interested in technology (Henwood et al. 2001; Herman, Ellen 2004) or to study the interactions between designers that may lead to gendered design choices (Oudshoorn et al. 2004). Another method is to closely study the gendered interactions in classrooms that may lead to gendered interactions with IT (Volman 1997; Stepulevage 2001). Similarly, interactions between IST and the users have been studied, to clarify the agency users have in adopting gendered technologies and to create more awareness for plural and diverse experiences. Several books have recently been published on how technologies are incorporated in everyday life at home (e.g. Berker et al. 2006; Lie 2003; Rohracher 2005).

Our conclusion is that gender studies as a whole have gained something from each perspective on gender and IT. From liberal feminism we have learned to pay attention to women: where are they, why are they excluded, what barriers do they encounter, in what ways are their lives being supported (or not) by technology? From standpoint theory we learned to look for feminine connotated values: in what kind of society do we want to live, what values and priorities are being supported by technologies and the technological culture and what hidden norms shape ourselves and our society? And from post-structuralism we have learned the importance of language, of deconstructing the values and dichotomies that are presented as given, the importance of gender identity formations and how gender and technology co-construct each other.

Although we have defined researchers as belonging to one or the other tradition, this does not necessarily mean that they would place themselves in that tradition or that their work solely or even comfortably fits within the traditions in which we have placed them. The division we have made is meant to show how diverse gender research approaches to IST can be, and the reader can find elements of each research framework throughout the various chapters in this book. In practice, most researchers, just as the authors here, have been inspired by and have adopted elements from several research frameworks, which is also the reason why we have not tried to place the contributions within the frameworks.

Clearly, gender studies encompass a multitude of approaches, disciplines and methods. What, especially in the past, has been common and specific about women's studies has been its close relation of theoretical analyses with political aims of facilitating changes in society to improve the position of women. However, as gender studies gradually became embedded in academia, its emphasis has shifted towards analytical, deconstructive research questions, which are relevant for changing society.[4] Such gender studies approaches run the risk of sticking with the mere analysis of how technologies 'could have been made otherwise', without being able to offer alternatives.

This book is the result of combining a gender studies perspective with a computing science perspective. Computing science implies focusing on the construction of technologies and on how to change society by (re)building information technology. In the combination of computing science and gender studies the authors of the chapters in this book have tried to be critical while at the same time constructive and proactive in formulating alternatives. But first we turn to the field of socially oriented software design as a subfield of computing science to find out about its specific traditions, perspectives and methodologies and to explore in what ways gender research fits with it.

[4] The renaming of women's studies to 'gender studies' is important in this respect: the focus has shifted from improving the position of women towards analyzing the way gender (masculinities and femininities), often combined with other axes of diversity and inequality such as ethnicities, race, age and sexualities, is constructed in society on various levels.

3. Socially Oriented Software Design

At first glance computing science does not seem to invite cooperation or easily integrate with gender research. In this section we will review the historical emergence of the field of socially oriented software design, a subfield of computing science that most easily lends itself to being combined with perspectives from gender studies[5], and we will point out the relations to gender research.

Software development[6] is a central issue in computing science. It generally proceeds in a sequence of phases, starting with requirements analysis. Here the structure and the present situation of a particular application area, the goals and needs of the actors and stakeholders are assessed and analyzed, and the necessary software functionality is determined. Most gender research referring to software development introduced gender as an additional analytic aspect to characterize contexts and actors. In the subsequent more constructive phases the software concept is specified and described in increasing detail and formality, finally leading to the implementation of a program in a concrete socio-technical environment. Much less gender research has been done with respect to the constructive phases.

The socially oriented approach to software design places particular emphasis on understanding the organizational and social context of the software development process and the use of software, comparable to what has become known as 'human-centred systems design' in Scandinavia and the UK (Pain et al. 1993). Scientists and practitioners who represent this approach develop and use methods and description techniques that allow for an intense involvement of the later software users in requirements analysis and in the development and evaluation of design ideas.

In the early years of computer construction and use, computers were exclusively used by scientists from the 'exact' sciences, like mathematics or physics, who programmed the machines for their own use. In their programs they dealt with problems already formalized (mostly mathematical calculations) or modeled problems and processes that were relevant and well understood in their scientific contexts. If their programs would not work or if the results seemed unlikely, these programmers knew well what they had wanted to model and to achieve and they were able to eliminate their own errors.

In the 1970s, the early time of interactive computing, computers were introduced to more and more fields of society and non-computer experts increasingly started using software for their daily work. Systems were designed for them -- users and designers became two separate groups with different professional backgrounds and expertise. Often in human-computer interaction, users did not know what they were allowed to type in and what the subsequent output meant. In cases of malfunction they had to wait for experts

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[5] This is not to say that there are no other candidate fields.

[6] 'Software development' and 'software design' are often used as synonyms. In the context of 'analysis and design', 'design' denotes the more constructive later phases of software development.

to help them. They often experienced computer use as complicated and annoying and not very helpful for their professional tasks. Users wished interaction to be more ‘user-friendly’; the academic field of ‘human-computer interaction (HCI)’ was formed (for overviews see Myers 1998, Maass 1993).

Graphical user interfaces as we know them today were expected to diminish these problems. The new interaction paradigm, ‘direct manipulation’ of ‘objects’ in ‘windows’, had been developed in cooperation between computing scientists and cognitive scientists taking into consideration what was known about human perception, thinking and learning (Shneiderman 1983). In fact these interfaces required less specific knowledge and skills about computers. Software developers started to distinguish between ‘naïve users’ (meaning *computer*-naïve), ‘occasional’ and ‘expert users’. In order to help naïve users, software use was made as simple as possible. This may be quite convenient for users, but also keeps them from learning more about how the computer works or how they can use application programs in more sophisticated ways.

A technical system that is to facilitate human work not only must be usable but also useful or ’task-adequate’ in the sense that its functionality has to match the tasks to be accomplished. Software design has become an important part of work design in that it shapes work processes - it enables or interferes with them. Software not only incorporates assumptions about users and their work but also mirrors the designer’s respect for that work. Gender stereotypes concerning work done by women can lead to inadequate software design. The resulting product may simplify the tasks, thereby reducing the necessary competences and preventing workers from extending their skills. It may even fail to support the workers' jobs and make it more difficult for them to reach their goals (cf. Jeanette Hofmann’s early studies of word processing systems, Hofmann 1999).

In office work a lot of relevant work activities may remain unseen by observers: communication and interaction work that is mostly done by female office workers is considered as just requiring their ‘natural female’ skills and no serious education. Outsiders like systems analysts may easily overlook or undervalue these aspects of work (Webster 1993; an example case is described by Maass and Rommes, this volume). Systems design based on such patchy analysis is prone to be task-inadequate, it risks either to make work more complicated by the software or to keep users in place with overly simple task models and thus to reproduce a gender-specific division of labor.

In the 1980s the European trade unions called for more workplace democracy and user participation in technology design and introduction. The first participatory projects started in Scandinavia and Germany (Bjerknes, Bratteteig 1994). At that time in particular the German-speaking ‘Software-Ergonomie’ research community (the equivalent to the Anglo-American HCI-community) started to cooperate with work scientists to make sure that software design did not interfere with good work design.

Mainstream software practitioners who did not follow the socially oriented approach often were surprised by the fact that the users of their systems were not content and were reluctant to use the systems. The dominant software

development practices with their traditional emphasis on formal analysis and description techniques that designers regarded as ‘neutral’ or ‘objective’ turned out to be inappropriate as they were unintentionally biased. Systems did not fit the users’ expectations and needs because, without being aware of it, the designers had assumed that future users would have the same abilities and preferences as they did and had designed for people like themselves (“I-methodology”, cf. Akrich 1995; Rommes et al. 1999). Critical scientists from software engineering as well as from HCI were confirmed in their view that good software cannot be developed by software experts alone. They called for more communication between designers and ‘end users’, so software designers could better understand the particular area of business and work their software would be applied to.

This directed more attention to the practices of requirements analysis. Various new ‘participatory’ methods were developed or appropriated from other fields, in particular from anthropology in order to investigate users' tasks and needs (Blomberg et al. 2003). Prominent software companies started to include anthropologists in their research teams and used their field methods of enquiry. The users’ application knowledge and work experience that tend to stay invisible with traditional analysis methods were discovered as crucial resources for good design; they need to be acquired by means of qualitative interviews and observational studies (cf. Suchman 1995). This new and respectful attitude constitutes a significant shift in the relationship between design and use, putting an end to the traditional higher esteem for design activities in comparison to use activities.

Due to their different professional backgrounds, designers and users have no common set of representation techniques. A lot of ‘participatory design’ research addresses the question of what kinds of representations or descriptions can facilitate a balanced, respectful and productive user-designer communication and cooperation and thus the empowerment of users in design. Michael Muller (2003: 1054) points out that the general concern of HCI research is “to bridge between two spaces – the world of software professionals, and the world of end-users”. In his survey article he characterizes recently developed participatory design methods that fall in the “hybrid realm” between the distinct work domains of developers and users as an attempt to create a “third space”. Such third spaces “contain an unpredictable and changing combination of attributes of each of the two bordering spaces”, Muller explains, referring to cultural theory (ibid.: 1053, Bhabha 1994). Cooperative workshops will “introduce novel procedures that are not part of conventional work practices” of either party (Muller 2003, 1056). Storytelling techniques are conducive to the formulation of individual experiences and perspectives and allow compact and yet comprehensible descriptions and stimulate discussions. Design games serve as levelers as they put all group members under the same rules of play and enhance joyful communication among them. The cooperative creation of descriptive artifacts promotes the mutual exploration of positions and approaches, resolution of conflicts and combination of views. Taking heterogeneity as the norm, ‘third spaces’ further mutual learning, the challenging of assumptions, and the formation of new ideas. The concept of ‘third space’ and the various

mentioned attributes and aims indicate a close affinity between participatory design methods and gender research approaches which call for a crossing of boundaries, the look from various perspectives and the reflection of silent assumptions.

Cooperation with users in the analysis and construction phases allows designers to discover and describe work processes in detail and to investigate and specify what system characteristics are desirable from the workers' points of view. As opposed to such participatory methods, traditional computing science methods are based on the assumption that structures and procedures which are to be supplemented or substituted by a software system can be identified 'objectively' by means of formal methods and with minimal direct user contact. Computing science is firmly rooted in the positivist tradition of natural sciences and the development of formal descriptions for objects and processes is a core issue. Software developers are trained to use and produce descriptions at various levels of abstraction; a software program is only the last step in a row of abstractions. In order to develop a program that automates or supports work activities in some area, developers have to make out the relevant elements und structures underlying and surrounding these processes. For a long time, the dominant assumption in computing science was that structures in our world are 'given' or 'real', so software developers just need to 'discover' them and then build a 'correct' model in their software. This myth of objectivity has often been criticized, not only by feminist science and technology researchers but also from inside computing science.

Christiane Floyd, one of the early proponents of participatory design in Germany, suggests a "new understanding of science" in her introduction to the book "Software Development and Reality Construction" (Floyd et al. 1992): "It embodies an awareness of how the observer constructs reality by the act of observation, how the questions we ask influence the answers we get and how we interpret them" (Floyd 1992: 19). In her opinion "an important aspect of computer science is that it deals with *creating reality*: the technical reality of the programs executed on the computer, and the conditions for the human reality which unfolds around the computer in use" (Floyd 1992: 20, original emphasis). This human reality, we would like to add, is structured by gender relations and technical systems have consequences for gender relations.

Instead of relying on the traditional categories 'right' and 'wrong', Floyd continues, good quality in software development and use requires that we "go beyond them by finding categories for expressing *the felicity of our choices*, for distinguishing ‚more or less desirable' as we proceed in making distinctions and decisions in communal design processes" (ibid.). Contrary to the myth of objectivity we must see software construction as happening in a social context, shaped by viewpoints, interests and power structures, and the resulting product as depending on who is involved.

Developers have to carefully reflect their own positions in a world that is – among other factors like class, ethnicity or age – structured by gender. Without this, products may turn out to be unconsciously biased (see above "I-methodology"), unusable and task-inadequate. Thus software development

can benefit from gender research. A combination of insights into gender issues on a theoretical level (e.g. gender-specific division of labor, gender connotated values and skills and gendered identity concepts), detailed studies of users and use contexts as well as direct involvement of users in the design (participatory design) will help designers in the construction phases to make decisions that explicitly take up and shape social reality, including gender relations. Such decisions may lead to Information Society Technology that supports and empowers a diversity of users.

4. Gender Research and Computing Science: Combining Deconstruction, Construction and Empowerment

The current transformation process towards the Information Society relies on the use of information technology not only by institutions but also by all citizens. Society in general is gendered and so is the Information Society, as we pointed out. Information technology itself plays an important role in enabling or preventing equal participation. Choices made in software design immediately influence the possible uses and the necessary user skills: they affect work and educational processes. Participatory strategies are being introduced into mainstream software development practices as taught in computing science to better meet users' needs and interests. As gender research has shown, gender relations shape and are shaped by the material world around us, and increasingly software forms a part of that world.

As described in section 2, gender research in the field of technology has been done from various perspectives. It has focused on analysis and deconstruction rather than on constructing alternative software programs. How can gender research actually inspire concrete software construction and lead to an empowerment of formerly excluded groups? As modeling decisions are not only determined by rules and technical necessities but also follow social preferences and interests, gender research can inform technology construction by particularly making software designers aware of their own (gendered) social assumptions and of the social consequences of the technology they create. So they will be able to critically reflect and adjust their assumptions or at least make conscious and explicit assumptions.

However, there seems to be a methodological gulf between gender research and computing science, between gender analysis and traditional software development, and deconstruction and construction that makes the transfer of results quite difficult. While post-structuralist gender research tries to open up categories and challenge distinctions, technology construction needs clear categories. This is particularly true for traditional requirements analysis that mainly focuses on formal modeling, but on the way from requirements analysis to some final system any informal models at some point have to be transformed into formal models with well-defined constituents and behaviors, filtering out 'irrelevant' details, irregularities and variety. At this point gender research has to make sure that gender aspects are perceived as relevant without essentializing gender.

Liberal feminism draws the attention to the particular situation of women; research from standpoint theory, too, works with rather clear-cut categories of

masculinity and femininity. Hence it is not surprising that designers have mainly (if at all) used the insights from those research frameworks (see Rommes 2006). But, as discussed in section 2, by doing this, they run the risk of essentializing either women or IST; of either reinforcing gender stereotypes or forcing women (or those who do not fit the norm incorporated in technologies) to change, educate themselves or stay out. Post-structuralist gender research has clearly shown that the fixation on 'what it means to be male or female' reduces people's options and cuts down on their freedom of action while leaving dominant gender structures in society intact.

Post-structuralist analysis, however, goes very well together with participatory design approaches. Researchers and practitioners of socially oriented software design have already opened up the traditional view of software development by putting forth user-oriented criteria for good software quality (usability, task-adequacy), criteria that cannot be formally applied but must be interpreted for every particular context, and new non-formal (participatory) techniques to involve the later users in analysis and construction. Similarly, post-structuralist gender researchers avoid categorizations, they rather focus on how these categories are constructed and hence can be avoided. One of the main points of post-structuralist researchers is that 'designing for all women' is not possible, but rather that designers need to study each particular application context. Techniques adopted from socially oriented software design can be very suitable for this as well as empowering for the women involved, as will be demonstrated by several chapters in this book (see also Kreutzner, Schelhowe 2003).

The various approaches to gender research presented above provide starting points for a critical assessment and an improvement of technology design in the sense that they allow for equal opportunities in the Information Society. Interest in gender research hopefully will rise, as the official directives for publicly funded research (like in the EU Research Framework Programs and IST programs) require scientists to include gender in their research projects.

We intend to explore and exemplify the relations between gender research and software design and thereby inspire innovation as well as further research. The case studies presented in this book will show how gender research can lead to gender-sensitive software construction, how conventional software design could have been improved by applying gender research, but also that basic aims of gender research, like the dissolution of fixed categories, are challenged by the necessity of formal determination in software construction.

The book brings together theory and practice of gender research and computing science and explores their mutual relevance. The interaction of gender and computing science is explored on several levels: first, analyzing IST design and scientific innovation processes from a deconstructionist view; second, describing and analyzing the rationale of concrete construction processes and software products; and third, showing the relevance of both for technical education and empowerment.

Summarizing the Chapters

As a start, and complementing this introduction, *Heike Jensen*'s article on the World Summit of Information Society WSIS focuses our attention on the relevance of information technology in the global design of the Information Society. Jensen asks whose policies are represented in the visions and the planning process. She analyzes power structures between men and women in the decision-making process of WSIS and finds that these prevent the discussion of issues that would promote equality.

In **part II "Analysis and Deconstruction**" the specific standpoint of researchers of both gender and IST is explored and exploited for a critical analysis of society and information technology. The authors of the first two chapters apply critical gender-analytical perspectives to some of today's highly visible fields of innovation. The authors of the third chapter reflect on their own working conditions as gender researchers inside computing science.

Jutta Weber and Corinna Bath analyze how computing science scholars infuse their creations such as robots and software agents with 'sociality' or 'emotionality'. They show that in order to make machines appear social or emotional, computing scientists utilize gender stereotypes. As they construct the 'future' by designing technological innovations, these scientists perpetuate existing social and emotional characteristics of humans in their most reduced and standardized forms. Are computing scientists creating a world in which humans one day will be forced to stick to even more confining standards of social and gendered behavior than today?

Cecile Crutzen analyzes and critiques developments in the field of ambient intelligence where networked devices surround humans, register their presence and actions, and react even before a person realizes that her environment needs to change. Crutzen argues that the space needed for interaction with the technology – what she calls "transformative critical rooms" – will disappear in such scenarios. How will gender be interpreted by such 'intelligent' devices, will they again stabilize the existing fixed meanings of gender?

C*hristina Björkman, Pirjo Elovaara and Lena Trojer* discuss their positions at the boundaries between disciplines as well as at the boundary between the inside and the outside of academic knowledge production. They reflect on the new turn in feminist technoscience from analysis and deconstruction to intervention and construction. In their own research they are hindered by, and at the same time challenge, the boundaries they encounter. They conclude the chapter with a list of the potentials and challenges of feminist technoscience research.

In **part III "Construction of Information Society Technology"** software systems are analyzed that have been unconsciously gendered and alternatives are discussed. The chapters provide case studies for how gender research can inform and inspire design processes. The authors demonstrate how gender research in computing science can move from deconstruction and critique to gender-conscious software construction.

Susanne Maass and Els Rommes give an example of how gender research

can be used to improve software products and software-supported work processes. They analyze call center software and find that unconscious gender stereotypes have guided the design and now interfere with call center agents' service work in customer interaction. Crucial and gendered aspects of the agents' work have remained invisible to the analysts. The analysis instruments, too, need a critical revision in order to become applicable to a wider diversity of work contexts. Based on their gender analysis, the authors suggest changes in the work organization to enrich the jobs and modifications of the software to make it more task-adequate.

Tanja Carstensen and Gabriele Winker look at women's organizations' uses of and needs for information technology and analyze them from a gender perspective. They present a case in which they themselves set up a database of women's projects and implemented tools to search it and to add further feminist projects. They describe the conceptualization phase, design phase, and users' reactions. The case study exemplifies the problem of combining construction and de-construction: their software design required to find clear categories for the database, the heterogeneous feminist groups for which it was designed, however, would have preferred to avoid restrictive categorization, as this is currently much discussed in post-structuralist debates.

Tanja Paulitz provides an analysis of the procedures and results of two design projects, one incorporating unconscious gender stereotypes and one paying attention to gender research results. She explains how and where both strategies affected the success of the designed systems and suggests how the first project could have gained from explicitly applying a gender perspective.

In **part IV "Education and Empowerment for the Information Society"** the interaction of specific information technologies with people and their lives is discussed. While in the chapters above authors discuss the necessity of gender-sensitive design processes, the authors in this part have tried to improve technologies and developed teaching material to make software and teaching practices more empowering. Several case-studies are presented in which educational aspects of software design and technical aspects of teaching practices are discussed.

Ruth Meßmer and Sigrid Schmitz study gender in e-learning scenarios. They describe a method of teaching technology courses for mixed groups of computing science students and gender studies students. They argue that the method helps the computing science students as future IST designers to understand the impact of gender categories and to develop some degree of gender-sensitivity. At the same time, gender studies students gain insights into the implementation of design decisions in technology. Both groups of students seem to have taught each other. The authors outline the characteristics of these courses and describe processes and interactions they observed.

Edeltraud Hanappi-Egger developed a computer game that mirrors the fact that life and the world are gendered and invisibly determine people's options

and decisions. The game is made for children, especially for girls, and allows them to simulate important decisions in a girl's course of life (e.g. leave school, get pregnant) and to experience the consequences of their decisions. Besides the fun of playing it, the aim of the game is to create realistic situations that make the users reflect on their gendered lives

Bettina Munk provides an example of technology construction that is inspired by gender research results. She assumes that offering girls more appealing computer games can help raise their interest in computing science. Based on an analysis of girls' media interests and media use an educational cell-phone software geared towards these interests was developed that teaches basic programming concepts and procedures. Munk suggests this as a way to combine technology experience with fun for girls.

Susann Hartmann, Heike Wiesner and Andreas Wiesner-Steiner present robotics as a field that can provide children with technological design experience. They analyze the effects of robotics workshops on girls' technology interests and career visions. The authors find that the technical robotics material itself is gendered and has an impact on the gendering of group dynamics and on 'doing gender' during the workshop. Designing and programming robots turned out to raise girls' anticipation of a technical profession if both, course concepts and technologies, were gender-sensitive.

Although the authors are from various disciplines and use different research frameworks, they all share some basic questions: What are gender aspects in IST development? Why should gender be integrated in analysis and design? And how can this be done? A gender perspective on IST serves as an eye-opener to study power structures, symbolic attributions and individual inequalities in society. Together, the chapters in this book show that many decisions in designing a course, in developing a technology or in constructing society are (unconsciously) gendered. They illustrate that developers, teachers and policy makers do have choices and they can choose to make a difference.

We hope that our diverse readers will feel inspired and encouraged to include gender in their research, teaching and development practices. Only with conscious attention to gender issues a "people-centered, inclusive and development-oriented Information Society" as claimed in the WSIS Declaration[7] can be achieved.

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[7] See footnote 1.

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