Change@Campus Karlshamn
Our Story

Culture, Norms and Gender at Blekinge Institute of technology

Christina Björkman, Peter Ekdahl, Pirjo Elovaara, Kerstin Gustavsson,
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Content

1. Introduction

Being a researcher and lecturer at a technical university or a technical faculty in Sweden means being situated in a culture, which is similar regardless of the university. It is heavily male dominated in numbers and masculine minted in approach. This culture has for its existence excluded not only women but also men, who feel uncomfortable in this culture. In the current culture all the choices made in the often advanced development of knowledge and technology create specific development directions and exclude others (Fox Keller 1992). This understanding of the operations of the academic technological sectors seldom create recognition, because the academic culture is perceived as "a culture of no culture" (Traweek 1992).

Blekinge Institute of Technology (BTH) is no exception in this regard. BTH is still characterized largely by being a mirror image of the traditional universities in Sweden and especially the Lund Technical University (which nowadays is part of Lund University). Male professors recruited to BTH from Lund in the south or Luleå in the north have more than once been using the argument "we don't do like that in Lund", "we don't do like that in Luleå", in order to correct activities at BTH into the traditional mainstream. Despite these correction attempts transformation ambitions have greater chance of getting into existence at a small, relatively new university compared to a multi-century-old university.

An experiment to develop a different culture and try out development of new educational programs and research, have actually been possible at BTH. This attempt has been made easier by the fact that it coincided with the development of a new campus in the small town Karlshamn with very good relations between local government, the university and private sector in the university campus focus areas. Criterias and absolute requirements for existence are recruitment of a relatively large number of students and the throughput of the same, delivery of a high number of doctoral degrees plus high degree of external funding for research. These requirements have been met and the experiment has thus been somewhat left alone or not been too much disturbed in order to evolve.

A must for an academic culture transformation of our technical sector namely media technology, is an epistemological base, which makes it possible to work us out of "the culture of no culture". This requires quite a radical but still academically legitimate grip. We use Feminist Technoscience as an epistemological basis of transformation and development. This has proven effective, as we look back at our history, which now has become more than 15 years.

Chapter 2 provides an introduction to Feminist Technoscience, which is deepened in *Chapter 3*. In the latter trustworthy intervention is also discussed. In *Chapter 4*, we approach computer science, which is a strong cultural agent for media technology and move into *Chapter 5* to provide a concrete example of trying transformation in teaching programming followed by, in *Chapter 6*, an insight into the changes that have occurred and approaches chosen in the media technical programs at BTH, campus Karlshamn. Working with culture transformation efforts has its specific purposes. One of the purposes is to create an academic environment where men and women equally can feel comfortable and develop their abilities and dreams. This is further discussed in Chapter 7 focusing norm critical game culture. We end this book in an *Epilogue*, in which author's voices are heard in thoughts on gender equality at technical universities.

2. Feminist Technoscience Stories

As a start we provide a short introduction to a number of different perspectives we have identified when studying how arguments and motifs for gender equality have been formulated in various organizational contexts, from single work places to an overall societal level. We want to emphasize that our structure does not imply any chronological order where the perspectives are independent and temporal entities. Quite contrary the perspectives are very much alive in the contemporary gender equality work and often one can find policies and other documents where the perspectives co-exist and even get mixed. Our intention is not to evaluate, i.e. to point the best or most successful perspective, but to use this structure exercise as a memory note and also as an analytical tool when developing methods and objectives in daily gender equality practices. We aim to relate the work we are engaging in to our diverse technoscientific practices and discuss if and how these practices can be mirrored against landscape of gender equality perspectives. How do we interpret and implement gender equality in our concrete academic practices, both within undergraduate education and research? How can these two layers of knowledge production be connected to feminist technoscience as well as adding layers to expand our understanding and definition of gender equality.

Add Women - increasing the number of women

The first perspective in our exploration focuses on the quantitative arguments for gender equality. For a long time work on gender equality has been focused on women; especially in the 'absent' women in certain areas and make visible 'the forgotten women' in some other areas. Based on studies, investigations and surveys various projects and activities have been developed and implemented in order to increase the number of women. These activities can for example be found in the field of education in order to attract women to choose male-dominated educational programs, especially within technology and engineering. The goal has been quantitative presuming that by adding women and increase their numbers we get a more even gender representation, in other words, a more gender equal society.

Take advantage of the experience of women as part of the diversity that enriches and adds new skills and knowledge

However, besides focusing and emphasizing the quantitative gender equality objectives, i.e. counting the number of men and women, more qualitatively oriented factors have been used to motivate the importance of balanced gender participation. According the qualitative perspective increasing the number of women is supposed to increase the quality of those more activities and women inclusive contexts. It is argued that the quality of activities and practices ,when women participate, will simply by definition be of better quality. The improvement of the quality is realized as women will bring in a broader spectrum of specific skills, knowledges and experiences. This argument has been and is used as the manifested principle for the need and importance to include more women. This kind of discussion sometimes has taken and takes a direction of an essentialist view of women. Women and men are different by definition and to strike a balance in the world of work both their efforts and participation is needed.

Creating room for women - women's own agency and action

When continuing our exploration, we can see there have been and still are gender equality activities, networks, projects and arenas only directed for women. It has been argued that women need their own 'rooms' to be able to share, communicate, develop and appreciate their experiences and skills and also develop new ones. In the Swedish tradition of gender equality work, one can better interpret the various arenas of women as a kind of temporal exercise arenas preparing and training women to eventually take steps to the male and male-dominated domains. This perspective gets strongly associated to the quantitative and qualitative arguments of increasing the number of women. Even if this would happen, the women only arenas can still be kept as parallel arenas for learning and communication.

The unexpected, border crossings

Are there other possibilities to make gendered practices visible with the aim to change and transfer them, than assuming a dichotomist understanding and interpretation of immutable gender categories? Within feminist technoscientific research future possibilities are placed beyond the traditional gender positions. In our technology dependent societies it does not longer create meaningful only to count the number of human players. We need a more serious and committed stance and involvement in the actual production of technology. The alternative is not to opt out, but find ourselves 'in the Belly of the Beast' (Haraway 1997). Being involved in the creation and implementation of technologies demands knowledge, commitment, a critical approach but also imagination, open-seeking and risk-taking. The directions within technology development need to be negotiated and determined in different configurations, in which both human and non-human actors interact. Daring to think beyond the given frameworks, to be innovative and responsible in a norm creative way requires a completely different view of technology and its role and place in our everyday lives. The trajectory of gender equality gets a new additional track; the epistemological questions demand our attention and energy.

We now leave the more general discussion and move further into our own context of feminist technoscience with the intention to situate the general discussion of gender equality in our own specific history. By this we hope our experiences will meet the world and its challenges.

From gender equality to gender research

Ambitions found in gender research within technology and engineering have developed into research transforming work with relevance in society and engineering faculties in focus. Conditions needed and created are epistemological pluralism. The gender research referred to is also called feminist technoscience.

When bringing forward discussions of gender in sectors like technology and engineering, we tend to go - as highlighted above - into a practice of counting heads i.e. how many women are present in which functions. More seldom are gender issues seen as knowledge and technology generating. What kind of value addition in certain academic activities can we find when starting in gender related issues? Epistemological comments on feminist technoscience are here presented as fostering and trying to advance our understanding of knowledge production in technology and engineering.

The research political debate on gender research in Sweden the last three decades has moved back and forth. Dominant voices in the reigning academic discourse have rarely put weight on the knowledge contribution from gender research regardless faculty areas. In spite of this circumstance increasing numbers of scholars within gender research find their way and place at the Swedish universities.

When it comes to gender research within faculties of technology and engineering, relevant research contribution has its specific challenges to be acknowledged. Why so? One obvious reason confusing the understanding of gender research as actual research is the visible gender (non) equality issue, that is the unbalance in number of active researchers. Women are few and especially so among the professor staff. The issue moves away from research to quantitative gender equality, which makes little sense, when it comes to knowledge production within technology and engineering. The second

and core reason is that gender research within technology and engineering is NOT primarily focusing gender - women and men. It is focusing technology, in order to be relevant as knowledge producing research. This means that gender researchers within technology and engineering quickly find themselves working with epistemological issues as the starting point for producing the technical knowledge, systems, artefacts etc. that are of relevance in the actual contexts of application and implication. The framework of theories and methodologies for this work is gathered from feminist research, nationally and internationally, as well as research fostering fundamental research transformations identified in society. From now on we are using the concept feminist technoscience instead of gender research within technology and engineering. This is a concept for us inspired in particular by scholars like Donna Haraway. The concept feminist research connotes change and transformation in a more explicit way than gender research, which is apprehended as less provocative and not touching the raw nerves of the academy.

Not only Donna Haraway but scholars like Sheila Jasanoff, Sharon Traweek and Elisabeth Gulbrandsen are convincing in their arguments about research as reality producing / world producing activities. Science is (co-)creating society and is thus political. That is why we are emphasizing also researchers to bother about the political aspects of their research. As scientist we have to see ourselves as producer of realities for us and for all others in society. If you find this statement too abstract just think of medical or ICT researcher. Explicit mode 1 (Gibbons et al 1994) researchers are of course provoked by this approach that denies the dominant epistemology of neutrality and objectivity as well as discarding the God trick ("god-trick of seeing everything from nowhere") (Haraway 1991 p.189).

Loosing up the rather categorical statement of feminist technoscience above, we want to give an example of a research project starting in a very traditional gender equality issue, which was found to bring fundamental reality producing results in society. There are no cut-in-stone processes within feminist technoscience but a call for openness for what makes research relevant in society, robust and leading to a liveable world for more than a few.

Fostering epistemological pluralism is a challenge at faculties of technology and engineering, however juvenile or old. When we have learned to spell the word epistemology, when we have acknowledged that we do research and teach by walking on a certain epistemological infrastructure, then it is high time to question this infrastructure whether it is relevant enough, appropriate enough for our located needs.

Situated at a technical university with an explicit profile of applied ICT in close cooperation between university, industry and government, the challenges are huge on the epistemological openness of us who are active at the university. The present knowledge and technology production occurs in situations far from what is identified by a traditional mode 1 (Gibbons et al. 1994) university – the linear model. These knowledge processes are our daily experiences at one of the campuses of BTH, more precisely at campus Karlshamn, which is integrated in an innovation node called NetPort. Karlshamn (www.netport.se). A too closed and non-reflected epistemological basis is a blockage of our daily work.

What resources can be used to stay confident, future oriented and innovative as an ICT researcher and an academic teaching staff? Referring to a now fifteen year development experience with so far good results in student recruitment, research and campus building, the resources for the epistemological infrastructures needed have been found within feminist research developed within a faculty of technology - that is within feminist technoscience. It might sound strange that we have found relevance within feminist technoscience for the benefit of building a needed epistemological pluralism.

From counting heads to research transformation

As mentioned above the history of feminist technoscience situated at faculties of technology and engineering has proceeded from the practice of counting heads (how many women) to fostering and advancing understandings and practices of knowledge production. This is not a linear process but more of a process in parallel. The gender equality work continues and is still far from reaching its goal in sustainable 40/60 % representation at all levels. The academic story in Sweden within a time frame of more than 3 decades shows that we have moved from the gender equality question, over the

woman question (e.g. developing cars or speech synthesizer suitable for bodies of women) to the science question. This is referring to the Harding turn (Harding 1991) moving from the question what science can do for women to what feminists can do for science. There are no simple or self-acting links between these general phases.

During these decades we have emphatically argued for the importance of perspectives from within (Trojer 2002). This is a central condition for feminist technoscience to be relevant and used at faculties of technology and engineering. Karen Barad has fostered this argument. She writes (Barad 2003, p. 828) that

> *"on an agential realist account of technoscientific practices, the "knower" does not stand in a relation of absolute externality to the natural world being investigated—there is no such exterior observational point."*

It is not enough to make gender research studies of technology from outside. It is equally important to be deeply involved in "the belly of the beast", a belly you are passionately interested in (Haraway 1991).

We persist to appreciate Haraway's (1997b) statement that

> *"Technology is not neutral. We're inside what we make, and it's inside us. We're living in a world of connections – and it matters which ones get made and unmade."*

This citation was put up on the wall in the lunchroom at a research laboratory focusing water jet technologies close to BTH. Together with a colleague we were hired to integrate some kind of gender research perspective in a EU project at the laboratory mentioned. The Haraway citation was almost impossible to comprehend for the water jet researchers in our introductory discussions. But some of them took the initiative to copy it and put it on the wall for further internal debates. Almost a year after this event, we came back for continued collaboration and found the involved researchers appreciating the citation and all the discussions it had nurtured.

Situated within the innovation system NetPort

In order to illustrate especially co-evolution and research transformation processes the following case is presented.

As mentioned above, the research division where we are academically situated has a specific history and obligation integrated in an innovation node called NetPort.Karlshamn (www.netport.se), here after named NetPort. NetPort is co-owned by the university (BTH), the local government and the industry in identified sectors (new media, ITS (intelligent transport systems) and energy). This relation of ownership is a strong signal of trying triple helix processes in reality. NetPort is not only a loose network of triple helix actors but organized and jointly owned in a challenging and inspiring way.

The start of NetPort coincided with the start of a new university campus of BTH in Karlshamn. Developing a new campus at a technical university in a triple helix context needs at least 4 starting conditions

1. undergraduate students
2. graduate students
3. epistemological acknowledgement of mode 2
4. tolerance towards resistance always appearing in development processes, especially university internally.

In the year 2000 the Vice Chancellor (VC) of BTH approved the department including the division of ICT and Gender Research at BTH to take the main responsibility of starting to develop the new campus. This task was supported by BTH with a centrally appointed project coordinator. The division had competence to start bachelor programs in media technology and was already running a PhD program with a number of doctoral students. The division staff was strongly motivated to work with practicing triple helix collaboration.

For his approval the VC had become convinced of condition 1 and 2 above. Condition 3 characterized the practice of the VC and seemed to be self-evident for him. The ambitions of the division to fulfil condition 3 were probably implicitly recognized by the VC as explicit interest was demonstrated in cooperation with stakeholders outside the university, of which the local government of the campus city was the main partner.

Concerning condition 4 the division had great help of understanding different kinds of resistance manifestations by the experience

of Bo Ahrenfelt (2001). Peter Ekdahl (2005) stresses resistance in development and transformation processes to be important and energy creating, even though resistance is momentarily experienced as destructive and energy consuming. Without resistance the possibilities to focus the own direction of the development work is obstructed. In addition resistance helps to clarify what kind of development and transformation terms you need and in addition fosters dialogue.

Both BTH campus Karlshamn and NetPort started in the year 2000. NetPort Science Park was established in 2009. The status in 2014 for BTH campus Karlshamn included over 300 students in the bachelor programs Digital Visual Production, Digital Audio Production, Digital Games and Web Development.

The PhD program as well as the present research division is called Technoscience Studies and includes 4 profile areas namely Design for Digital Media, Feminist Technoscience, ICT4D, Innovation system and Development (for more information see bth.se/tks/teknovet.nsf).

The research division hosts an organization unit focusing on development of clusters and innovation systems in collaboration with developing countries. This platform is named SICD (Scandinavian Institute for Collaboration and Development, for more information see sicd.se). The team working at SICD has long term experiences from Sida (Swedish International Development Cooperation Agency), VINNOVA (the Swedish Governmental Agency for Innovation Systems) and BTH (Feminist Technoscience).

The engagement of the local government comes from the mutual 'project' NetPort of fostering sustainable development of the (local) society. The prerequisite for this 'project' is a triple helix-like process, which in our case is nurtured by a constant dialogue. In this dialogue, which is a kind of agora, mutual understandings are supposed to find their expressions in very concrete ways resulting in co-evolution processes. For us, who have been involved, we talk about an

> *"establishment of the institution of a 'kitchen cabinet'. A generous, open, inviting, allowing arena had to be created for the construction of new questions and dreams …. We need a lot of 'kitchen cabinets' on campus to cater for the polycentric, interactive and multipartite processes of knowledge-*

making we may dream of. A vision that entails transformative processes, changing research cultures and 'teaching smart people how to learn'" (Gulbrandsen 2004).

During the pioneer phase the dialogue within NetPort was intense and relatively easy to keep continuously going. Challenges of different kind were always present but possible to handle as the core group (kitchen cabinet) was optimal in number and the mode 2 experiences possible to share. As new colleagues and partners joined and the upscaling of NetPort activities continued, the kitchen cabinet became increasingly challenging to maintain. It is too easy to prioritize time for the increasingly advanced development within each partner's areas of responsibility before enough time for the triple helix co-evolving process. The sight of the co-evolving processes thus changes over time but the standpoint of keeping the main actors together is an absolute condition for sustainability.

With this short presentation of our work within NetPort fundamental concepts of feminist technoscience such as situated knowledges, transdisciplinarity and co-evolution have been filled with some substance for us active in the same place. For a more detailed discussion see Trojer (2014).

Freedom from and change to

As Elisabeth Gullbrandsen is emphasizing a central experience from work on integration of gender research and gender equality concerns the so-called "negative gaze," which identifies and uncovers barriers, structures as barriers to gender equality and gender perspectives on / in technology and which excellently illustrates the problems and what we want freedom from. The 'negative gaze' must be supplemented. We understand Integration as a research transforming work that demands us to increasingly create notions of what we want to change; what we want the freedom to; what kind of research and engineering sciences / technoscience we want. If we have ambitions to integrate our interests in a technical faculty, we must be able to produce visions, alternative narratives - which "make sense" - and say something about where we are heading, in order for us to, in collaboration / partnership with other actors and stakeholders, formulate concrete target scenarios and strategies to get there.

Knowledge production in open systems

The situation with more *open systems of knowledge* production requires a focus on the direct reality-producing dimensions of research; its context of implication (Nowotny et al 2001). According to Donna Haraway (1997, p.68), it is neither time nor place to develop relations of research to society "... after all the serious epistemological action is over." Neither sustainability nor other values that we want to realize, can be secured afterwards. It is these developing traits that have led Ulrich Beck to ask if the representative democracy is declining by the modern research complex developing as a separate policy field. "Politics breaks out into a new and different way, beyond the reach of formal responsibilities and hierarchies. So we are looking for politics in the wrong place, with the wrong concepts, on the wrong floors, on the wrong pages of the daily news papers "(Beck, 1996, p 24). In this situation impossible to overview, as Nowotny et al (2001) refers to a dedifferentiation of modernity society spheres, we place our research projects and efforts to promote more complex and integrated understandings of the relationship between research and society.

Situated Knowledges and Technologies of Humility

The concept of "situated and knowledges" was introduced by Donna Haraway as part of an epistemological and political effort to create alternatives to "... developing at home that voice of entitlement, the voice-of-control start, that accompanies the conquest of empires far from home ', as Sharon Traweek characterized the scientific mainstream "voice" (Traweek, 1992). Haraway views all knowledge as local, it is historic and culturally dependent. It is problematic to argue for watertight bulkheads between the research subjects and research objects, between the observing and the changing and between research and politics. The researcher is considered as an active participant in the research process, she creates and organizes knowledge in an ongoing interaction with the reality, 'on' which she is doing research.

Situated knowledges is a basic concept of technoscientific gender research (Haraway, 1988, 1997). We see an interesting parallel in

Sheila Jasanoff's challenges given to politicians and policy makers, in which she comments on the growing extent of co-production (co-evolution) and interactive models, which relate to science and technology policy (Jasanoff 2003). Collaborative development of science and society has led to increased complexity, unpredictability and irregularity in both realms. Jasanoff expands the discussion by arguing that policymakers need to develop a set of technologies of humility to evaluate the unknown, unspecific and uncontrollable, the ambiguous and uncertain aspects of the development of science and technology. Technologies of humility require different abilities and ways of engagement between researchers, experts, policy makers and the public, which differs from the regulatory and predictive 'technologies of hubris'. It is on the latter, which policymakers today are wasting much of their attention. Jasanoff is not alone in addressing issues of complexity and uncertainty in relation to science and political decisions. Brian Wynne (2003) and Jerry Ravetz (2000) have in very interesting and perhaps provocative proposals put the partial ignorance of science in the heart of the debate about how to understand, differentiate, express and communicate complexity and uncertainty. Overall, we believe that "situated knowledges" and "technologies of humility" are pointing towards the centre of the conditions for socially robust research and development of technology.

3. Black Boxing

In 2007 we, as a feminist technoscientific research group, asked ourselves, what kind of focus want we to develop as feminist researchers develop at a technical university within our own academic environment.

The first starting point for our discussion was our epistemological basis of feminist technoscience, see above, also implying attention to issues related to boundaries and boundary crossings between science, technology, politics and society. The feminist technoscience approach has revolved around exploring the epistemological foundations of knowledge understandings and practices – focusing on deconstructions, opening up concepts and definitions. By doing this it has

> *"…visualized science and technology as discourse, but has on the other hand been less good an agent for changing science/technology. Deconstructions have been made, but re-formulations have been less tangible." (Mörtberg 2003, p. 60).*

The crucial challenge is to move beyond the layers of deconstructions, and the core question becomes: how can feminist technoscience research be used for intervention and transformation?

Our second starting point is taken from the notion of IT, as a core field for our university. We are keen on opening and rearranging of the black boxed IT, in order to create new approaches, ideas and understandings as well as new possibilities for change. Paraphrasing Sandra Harding's concept of "the science question in feminism", in which she argues for a shift of focus from women in science towards science itself, its foundations, theories and methodologies (Harding 1986), we see feminist technoscience research as constituting a turn towards "the technoscience question in feminism".

Classifications and categories make boundaries

> *"My experience of the working relations of technology production and use has led among other things to a preoccupation with boundaries, including efforts to recognize them, problematize them, at times maintain them, and at other times to work across them." (Suchman 2002, p.93)*

Classifications and categories with its problematic boundary producing realities create spaces for some ones to live in and act from and also spaces where others necessarily do not have access to: "A classification is a spatial, temporal and spatio-temporal segmentation of the world. A 'classification system' is a set of boxes (metaphorical or literal) into which things [we would like to add: people] can be put to then do some kind of work – bureaucratic or knowledge production… Classifications are consistent and unique, mutually exclusive and complete." (Bowker and Star 1999, p.10).

The following four boundary-based categories identified by us through our practices and experiences within our own specific academic organisation, seem to be the most troublesome and powerful for our feminist technoscientific work:

a. The university structure in itself is firmly and explicitly based on disciplinary boundaries, hence both difficult and challenging when developing inter- and trans-disciplinary research as feminist technosicience aims to do do

b. The university definition and understanding of IT as a hard core technical category is difficult and challenging when working to broaden the understanding of IT.

c. Knowledge developed and practiced within academies of the Western worlds is often connected only to theoretical knowledge, thus it is

hard to recognise and respect distributed knowledge processes and co-operate with other knowledge producers outside the university.

d. The university as closed classification system based on mutually exclusive categories offers only limited if any space for change.

It demands no hard work to find academic categories and classifications since they are constantly named, listed and articulated as disciplines, departments, academic titles, professional positions, research areas, etc. These categories provide a repertoire of labels that help to describe oneself and also to find others belonging to the same categories. Smooth orderings and stabilizations. These categories, and boundaries between them, are a living reality, not just constructions, and most tangibly present in attempts at inter-/trans-disciplinary work. Disciplinary distinctions "all orient not only to different problems but more significantly to different, sometimes incommensurate conceptions of the social/technical world. "What hinders us, she says, are "discontinuities across our intellectual and professional traditions and associated practices" (Suchman 2002, p. 96).

These disciplinary distinctions are responsible for the difficulties and challenges encountered in broadening the understanding of information technology, an important category in our context, where the issue of knowing within categories is raised: "A crucial assumption underwriting these persistent boundaries is the premise that technical expertise is not only a *necessary*, but is the *sufficient* form of knowledge for the production of new technologies." (Suchman 2002, p.93, original italics).

Categories are mutually exclusive. If you are placed inside a technological discipline you cannot at the same time be categorised as a social scientist, and vice versa. Inclusion in one specific category means that you firmly and definitely are outside another category. This leads to an attempt to understand who is outside and who is inside when the borders are drawn, and what it means to be outside and inside, when talking about the power to define and the power to act.

Recognising and living within boundaries makes one wonder how powerful, well protected and stable these boundaries are. Are they transgressable? Contrary to Bowker and Star, Donna Haraway is

more hopeful "Categories are not frozen… The world is more lively than that, including us, and there are always more things going on than you thought, maybe less than there should be, but more than you thought!" (Lykke et al. 2000, p. 55). This is what gives us energy in our daily work, even the resistance, even the quiet one, makes the work of change hard.

How to challenge boundaries?

> *"…crossing boundaries as a project of mutual learning and partial translation…" (Suchman 2002, p. 93)*

Our research group, by its very existence within a technical faculty, challenges the boundaries of what is regarded and defined as technology. As we see it, information technology as a field of knowledge and expertise crosses disciplines. However, our experience and our interpretation is that there are forces striving towards disciplinary 'purity' and a very narrow engineering definition, where inclusions and exclusions are created and maintained. Our group, by asking questions and studying issues such as "What is information technology?", "Who draws the boundaries for what information technology is considered to be?", "Why are the boundaries drawn as they are?", "Who is excluded and who is included, and why?", and not least "How could it be different?" challenges such understandings of IT, in an attempt to open and rearrange the black box(es) of information technology and thereby creating opportunities to integrate engineering with questions related to design, and contextual and situated accountability.

Our research interests and questions often take their departure from experiences, either from within or outside academia. We acknowledge the understanding that contemporary knowledge and technology is increasingly produced in distributed systems, where the boundaries between universities, industry, government and civil society are flexible and under constant re-negotiations (Gibbons et al. 1994, Nowotny et al. 2001). The definition of knowledge, imperative in western universities, has considered theoretical knowledge as the only form of knowledge. This narrowness excludes above all knowledge understood as "practical intelligence" which is developed and used in concrete situations (see e.g. Göranzon 1991).

One of our epistemological foundations is to include not only our own but others' experience-based practical knowledge in our conceptual and practical understanding.

Trustworthy Interventions?

Feminist research has for a long time made great efforts to understand and develop the ideas of otherness and difference. Our experience tells us that this discussion is also extremely central and relevant when speaking about the focus of feminist technoscience on information technology. How do questions concerning differences and otherness need to be reformulated and situated in the context of information technology? We have seen that differences present in technoscience/IT practices often show up in tensions concerning issues of epistemology, knowledge production, expertise, participation and implementation, as well as in political and societal development. The world of information technology, as is the case for all other worlds, consists of power differentiated communities. This differentiation is at the same time an essential part of the different actors' collective dreams of "how things might be different" (Haraway 1991, p.93). There is no room for innocence, but at the same time there is also no place for never-ending conflicts. There should be room for

> *"an earthwide network of connections, including the ability partially to translate knowledges among very different…communities"*
> *(Haraway 1991, p.187).*

By recounting our experiences we want to show that this translation work – where there are no ready-made models or methods – is both possible and a very difficult task. We have no illusions that the work can be done immediately, extensively or without collisions.

Technoscience practices are so tightly interwoven with our lives that stepping outside of these to analyse and criticize is not a position available to feminist technoscience research. On the contrary, impure places and actions are the only options we have because we have to participate in situated, concrete practices "…that cobble(s) together non-harmonious agencies and ways of living that are accountable both to their disparate inherited histories and to their barely possible but absolutely necessary joint futures" (Haraway 2003, p.7). We would like to suggest a list of important challenges, issues and potentials that we see in feminist technoscience research:

- Expand the perceptions of technological knowledge and development.
- Indicate alternative directions of technology/IT applications.
- Make the cultures within technology-related institutions explicitly visible (phase out "the culture of no culture") and thereby show that no research positions are innocent.
- Establish new fora for the development of understandings of the relations between research and politics.
- Act as catalysts for inter- and trans-disciplinary constellations.

This list can be seen as conditions for attempting transformations. But how can we initiate and participate in a movement that aims at trustworthy interventions and processes of change? As the list suggests, the work cannot and ought not to be done by feminist technoscience researchers alone. When one of the fundamental bases for change is to look for and build alliances, we have to learn to co-operate – also with people who do not always share our own epistemological and political concerns. We have to learn to ask new kinds of questions about alliances and collaboration because the alliances and collaboration partners might be in many ways unexpected and strange. The questions are both complicated and absolutely necessary, as Donna Haraway, referring to the work of Helen Verran, writes:

> *"How can people rooted in different knowledge practices 'get together', especially when all-too-easy cultural relativism is not an option, either politically, epistemologically, or morally? How can general knowledge be nurtured in postcolonial worlds [or other worlds – our addition] committed to taking difference seriously?" (Haraway 2003, p. 7).*

Taking differences seriously means that there is a need to find a position from which to act, where it is possible to respect differences but not to be satisfied with the relativist thought that 'anything goes'. What is instead needed is a desire to get involved in respectful conversations without losing our own feminist epistemological intervention goals.

4. Computer Science

In chapter 3 we discussed boundary crossings and interventions. In this chapter we are entering into feminist computer science research developed at research division of Technoscience studies at BTH via Christina Björkman's research. This involves issues concerning integrating feminist technoscience research issues into computer science, in particular education.

Thinking Modes

Björkman's background is within engineering and computer science education at university level. The "world" of engineering/computer science is in many ways fundamentally different from that of feminist technoscience. What does it mean to be simultaneously an engineer/computer scientist and a feminist technoscience researcher?

In formulating and thinking around experiences of being an engineer, a computer scientist and a feminist tecnoscience researcher, the notion of "thinking mode" can be used (Björkman 2005).

Evelyn Fox Keller (1992) sees the concept of "mind-set" as representing a key difficulty in the meeting of feminism and science. Her

concept can be useful in throwing light on and understanding some of the problems involved in this meeting. "Mind-sets" is essentially indicating the same idea as "thinking modes". Below these "thinking modes" are presented in a table of opposites.

The engineer	**The feminist researcher**
HOW	WHY
"Physical"	"Mental" (attentive to language)
Solving, explaining	Understanding
Answering	Questioning
Constructing	Deconstructing
Sharpness, clarity, logic	"Wooliness", diversity, richness
Rationality, linearity	Freedom, reflexivity, associativity
Enclosing, "zooming in"	Expanding, "zooming out"
Homogeneity	Heterogeneity
Simplicity/simplification	Complexity

These "thinking modes" can be felt almost physically in the head. It is as if putting the brain into different states.

The first pair in the comparison above is an attempt to summarise the main question / perspective from the engineer's/feminist researcher's positions. The second pair is an attempt to describe where focus is 'felt' to be: as engineers we can feel as if we focus the very concrete, physical 'real' world, whereas as feminist researchers our attention feels more geared towards mental or linguistic dimensions. But these are not mutually exclusive; of course we focus on the concrete world also as feminist researchers. The words above are meant to describe the feeling, which in turn probably says something about how an engineer experiences what it means to learn new and very different ways of thinking and working: those of the feminist researcher.

The engineers thinking and reasoning is logical, rational, linear, enclosing and simplifying, while the feminist researcher's is expanding, reflexive, associative and complex - two quite different ways of thinking.

The table above is meant to describe how the "mind-set" of the feminist researcher is in many ways very different from that of the en-

gineer and computer scientist. These differences originate to a large extent in the different epistemologies, which we see as linked to issues such as culture and education. Awareness of these different "mind-sets" is important, if we want to cross boundaries and engage in change processes.

Knowledge and knowledge processes within science are of particular interest for feminist analyses. In the sections below, we discuss some knowledge issues in computer science through a number of themes.

Feminist Research Meets Computer Science

Both feminist research and computer science are competence areas, but they also bring with them modes of thinking about the world as we discussed above. Feminist epistemological thinking has the potential to enrich computer science. Norwegian informaticians Tone Bratteteig and Guri Verne see *"epistemological inquiries to establish alternative understandings of knowledge"* as being the most challenging and having the greatest potential for contributing to change in computer science, (Bratteteig and Verne 1997, p. 60).

Bratteteig and Verne (1997, p.70) also state

> *"We do not accept the dichotomy between feminism and technology. The challenge is to learn to live with, and possibly harvest from, the contradictions and alleged paradoxes that arise."*

Teaching and Paradigms

What happens when feminist technoscience research meets computer science (CS) educational practice? Can the former shed new and unexpected light on the latter? A goal is to try to make hidden views and expectations visible, and to work for accommodation of greater diversity in the practices of CS as well as among its practitioners. In the long run, these types of changes can contribute to transformation of CS into a discipline that is more attractive to a broader range of students, for example women.

In a study undertaken at BTH Maria Alsbjer has used feminist research and feminist epistemological theory to discuss programming

education, in particular the processes involved in learning to program (Alsbjer 2001). The teaching of programming, and the 'paradigms' implicit in this teaching has been a special focus from the very beginning at the undergraduate education in media technology. Paradigms or metaphors take on a significant role in education. A rethinking of these could likely have significant impacts on *what* we teach and *how* we teach. The teaching of programming is of particular importance. Björkman's feminist comments here are: What does it mean to "understand programming"? What are the paradigms and views of knowledge, computer science and programming behind programming courses? Is this visible in the courses or not recognised but taken for granted? If and how a different paradigm or metaphor can promote learning of programming is a question that ought to be of great interest to the whole computer science community.

Presently the most important among new paradigms or metaphors for computing seems to be interactivity or interaction. This concept has been discussed by a number of researchers. To take some examples: Lynn Andrea Stein talks about a new computational metaphor: "computation as interaction" (Stein 1999) and Peter Wegner writes about "why interaction is more powerful than algorithms" (Wegner 1997). Heidi Schelhowe sees interaction as a successful approach to development of software (Schelhowe 2004).

Metaphors create images that are of importance in the knowledge processes. Different metaphors call for different ways of thinking. Can new and different metaphors or paradigms also support other ways of knowing?

What knowledge? Whose knowledge?

As we pointed out above, issues concerning knowledge are of particular interest for feminist research. What kind of presumptions, choices, standardisations, classifications etc. are involved in the knowledge processes in CS? So far, for example gender-marked representations and metaphors are neutralised, made implicit and integrated in the development of models, computer systems, etc.

A number of questions are relevant to ask around knowledge issues, such as: what knowledge is valid and why? Who can have knowledge? Who has the preferential right of interpretation and why? And "Whose science? Whose knowledge?" (Harding 1991). What does it mean to "know computer science"? Such questions can throw light on implicit scientific practices of importance. Finally, but not the least: How can it be different?

The practice of many computer scientists concerns production of software, including design. How is knowledge represented within software systems? And whose knowledge is built into software? Is this explicit or hidden and implicit? Different "models of the world" will result in different computer systems – and thus also different consequences for the users. How systems are constructed depend on who construct them, and what world-view and understandings of knowledge, experience, values and needs they integrate in the development and the final products. Who influences development is thus important to take into consideration (Mörtberg 1997).

Exploring the concept of situated knowledge could be useful: How can knowing situated in social and cultural contexts be represented, so that its situated nature does not disappear into universalising and de-contextualising?

An important focus for feminist researchers has been issues of design and use (e.g Bratteteig 2004). Software design and development is a complex activity, requiring knowledge not only of the technology involved but also knowledge of the area of use.

Feminist research may contribute to the discussion about use and design, and to develop other theories and methodologies, for example to account for complexity and for heterogeneity among users, in order to develop responsible and sustainable technology (Mörtberg 2003).

Questions about knowledge are important within the field of Artifical Intelligence. Alison Adam has extensively discussed epistemological issues in her work on artificial intelligence (AI) (e.g. Adam 1995, 1998). She claims that by using knowledge and experiences from feminist epistemology it is possible to get more radical insights into epistemological issues in AI, than when using more traditional

approaches (Adam 1994). She discusses the differences between propositional knowledge ('knowing that') and skills knowledge ('knowing how'), or mental vs. embodied knowledge, and how the former has been seen as superior to the latter (Adam 1995). For example, it poses big difficulties to represent skills knowledge and common sense in AI-systems, which means that only some types of knowledge will be represented in the systems.

An equally important question as "whose knowledge is represented in an AI system" is the question "whose knowledge is built into objects in object-oriented design?". Cecile Crutzen and Jack Gerrissen have made a feminist analysis of the object oriented paradigm (OO) (Crutzen and Gerrissen 2000). They argue that OO enhances the idea of the controllable and deterministic. They claim that object orientation is based on the idea that everything and everybody can be represented in terms of objects, an idea that they object strongly against. They argue that OO should not be used for the analysis of human worlds, but only for what it was originally intended: the realisation of software.

Many other questions regarding knowledge are important to ask, such as the crucial question: "What does it mean to know CS and how could it be different?". Knowledge and acceptance of different types of knowledge construction (see e.g. Alsbjer 2001) is essential for extending the view of knowledge within CS, and thus potentially accommodating greater diversity. We strongly believe that computer science, and in particular education, would gain from cherishing "epistemological pluralism".

Abstractions and naturalisation

In computer science, abstractions, formalisations and representations are important. However, there is little discussion about the role of these, and how they are used. Representations, categorisations and thus simplifications are necessary, but it is also important to look at how they are chosen.

Another important issue for research is the role of abstraction in computer science. Abstraction is held to enable methods to be value-free. Computer science focuses on understanding the world via a

rationality based in the abstract (Stepulevage and Plumeridge 1998). However, the products of computer science are very concrete. Why is abstract, formal and logical thinking and knowing seen as superior within computer science? This question is connected to the issue of how computer science relates to mathematics. Even though mathematics is important, computer science is in many (maybe most) aspects not a mathematical discipline. In contrast, computer science could be viewed as concrete science where important aspects are materiality and social practices (Clegg 2001).

Problems can arise when extending abstractions, formalisations and de-contextualisations too far out of their right environments, and applying them in other areas, which do not readily lend themselves to these kinds of descriptions, e g. systems design. The use of (necessary) abstractions could easily lead to abstracting away also ideas, values and meaning. Thus, abstractions, maybe without being noticed, diffuse into areas where they might not belong, and make us forget and realise complexities and social and cultural circumstances.

Computer science does require a certain amount of abstract thinking. However, there is no doubt also need (and space!) for what can be called 'concrete thinking', practical involvement, and not least concrete learning. This could introduce new ideas for gaining knowledge that can make CS more relevant to a more diverse group of people.

Closely related to representations is the concept of naturalisation. In the process of naturalisation, something (an artefact, an idea, a concept etc) is stripped of its origins, context and consequences, and is seen as given, as self-evident. What consequences can naturalisation have? For one thing, it is easy to see how everything, from hardware to software tend to be taken as 'natural', as something given, once they have existed for some time. This means that the reasons why things are constructed in a certain way are forgotten, and hence there is likely to be a tendency not to question whether this was actually 'the best way' to do something, thus contributing to technical inertia. Designers, machines and software are made invisible, thus hiding the choices that have been made during the processes.

Feminist analysis contributes to de-naturalisation of the objects created, for example software, in order to understand what intentions

and choices that are built into the technology, and can help bring back the active and process nature of technology creation. This will mean the objects and the processes will become situated in the context where they were created, and this situating brings with it valuable knowledge about the different circumstances surrounding the creation.

An example of naturalisation within computing is the computer itself. This becomes very clear in meetings with undergraduate students. To most of them, 'computer' does not only mean an artefact, but also a very special artefact – the PC of today! They (and probably most of us) take the construction of the PC for given; not only in the way it appears, but most of all in the von Neumann-model it builds on, and in the digital technology used. The historical contingency of the way that today's computer is constructed has disappeared. However, there is nothing 'natural' or given with the construction of the present-day computer, not even the digital technology used. For example, Heike Stach (Stach 1997) shows how von Neumann, in his design of the model, was greatly influenced by ideas within neurophysiology and psychology (behaviourism) of the time, and not the least of the emerging cybernetics and its ideas of self-regulation and control. He came to formulate his design in terms of the prevailing beliefs of that time concerning how the human brain works. Quite soon, however, the brain came to be thought of in terms of the computer. So – the computer is a brain, and the brain is a computer! The computer is thus an obvious case of naturalisation, where the choices that were made 60 years ago, and the reasons for these choices, are, if not forgotten, so at least never brought to the fore.

A feminist question/comment to this is: What does this naturalisation mean not only for our understanding of the computer, but also for our applications, which are, at the deepest level (machine organisation), completely dependent on this model?

Strategies Towards Making Change Happen

As discussed in chapter three above, if we as feminist (technoscience) researchers want to participate in transformation work, in processes

of change, we need to build alliances across disciplinary and other boundaries, starting in joint interests and engagements. If we want to participate in transforming a discipline, we also need to co-operate, and engage in dialogues with the disciplinary practitioners (Björkman, Elovaara and Trojer 2007).

We believe that it is most fruitful to start co-operation and intervention in topics or situations the (computer science) practitioners find relevant for their (educational) practices, or which arouse their interest and concern. Identifying meeting places or 'boundary objects' (Star and Griesemer 1989) on which to build functional alliances is important.

Co-operation requires us to see and talk about differences between disciplinary and scientific "worlds". As long as we deny the differences, we will not make properly grounded and thought out, but naïve and failed, attempts of communication, which run the risk of doing more harm than good.

Language is identified as one of the crucial and most difficult issues in co-operation and communication, or rather how epistemology and language are intertwined and thus complicate communication. It is important to recognise the differences in how we talk about science, learning and knowledge within different scientific traditions. Understandings and epistemologies are concretised in metaphors and words. When these do not harmonise, or differences are not recognised, communication can collapse, resulting in loss of transformation potentials. Furthermore, the different epistemologies and approaches to knowledge need to be made explicit, in order for us to be able to talk about them. Recognition of these difficulties underlines the necessity of developing translations or mediations. It is a translation on several levels, where the most fundamental level concerns what can be considered fairly different 'world-views'. The dialogues necessary for change can thus be made possible by communication and translation across boundaries between "worlds".

Feminist researchers can certainly contribute much to processes of change within science / engineering education. Knowledge about gender and issues of diversity spring immediately to mind. But there is another particular competence that feminist researchers can

contribute with and that is our knowledge about, and training in, critical reflexivity, reflexive thinking. We can point to and show how commitment to students and education can be strengthened and developed through critical reflection, that theory and practice can contribute to each other in a reflective spiral.

Connected to this are the issues of providing space and time for educational practitioners to think and talk about matters other than the very concrete everyday work, to afford them time and the vocabulary to reflect on a meta-level. As feminist researchers, with training both in reflexive thinking and in asking those unexpected questions, we can facilitate, encourage and stimulate this kind of work. We can draw to the surface thoughts and ideas that might already be there, as well as catalyse new thoughts.

New ideas about learning and the learner that are not entirely consistent with the 'traditional' epistemology in natural science / engineering have started to make their way into the teaching of (computer) science. When explicitly addressing practice in conversations, there is a subtle change in language, revealing more contextual and relational approaches to knowledge and the knower.

5. Situated Learning in Programming

Skills in programming are as necessary as breathing in the media technology undergraduate program. The big challenge at the start in 2000 was how to transform a non-efficient and obsolete teaching of programming offered at that time. It was a true challenge as one of the core competences at BTH was software development. But the pedagogic approach used in this competence field did not fit the needs of the media technology program and caused a lot of problems.

Images

A development project for the programming courses started in 2002 by Kerstin Gustavsson, teacher in programming, and Christina Björkman, researcher in feminist computer science with many years of experience in teaching programming. One main focus was to delete the image of programming as something very difficult and possible for only a smaller group of smart guys – an image nurtured in media, in the academy and explicit expressed by the first year students. This was in particular the view of female media technology students. Below voices from both a female and a male student is presented.

"My image of a programmer and his job is a bit divided. The first group are guys in high school, good at math and completely sold on their computers and do not care about anything else. Then we have the other group, who are men between 25-30 with good education. They are smart and rich in any "super" program that everyone needs."

Reflections written by female student 2002

"My view of programming has changed significantly since the course began. I thought programming would be much more difficult to learn and much more boring. Previously I did not think I would get much use of java but now I see opportunities and application areas. As my main interest is design I wait with excitement for the graphical part."

Reflections written by male student 2002

During this first course of programming as it was developed 2002 the students had to write reflections 4 times evenly spread from the start to the end of the course. Let us follow one creative student in some snapshots of her reflections.

Reflection 1

- with no experience in programming, this course is both frightening and tempting for me

- when I think of programming I see a bunch of inconceivable text in front of me

- I hope to understand the basic elements how programs are constructed and to see patterns in all presently inconceivable texts.

Reflection 2

- my view on programming has changed

- a lot of texts is plaited together…the most extraordinary things is emerging

- to learn programming for me is to have a small insight in how incredibly much that is behind what is perceived as self-evident in different programs

- I am a bit on my way to understand the basics…it is no longer frightening

- I feel spoiled…given so much help

Reflection 3

- my feeling for programming is a lot of words in different phrases and expressions, which believe it or not becomes a program if placed correctly

- the group briefing has been good with the repetition as I would like to have in order for everything to sink in properly

- but I can not say that I think it has been easy, it's been really hard sometimes, when everything goes wrong just because two little measly letters switched places and I think they are rightly placed

Reflection 4

- Yes, what have I learned? A lot I surely must say, given that I knew nothing about programming when the course began. The most difficult was when I had to get the GUI (graphical user interface) to link up with what we have done before. I really didn't get it together and it was so frustrating. But when it said click, I realized it was a lot of fun, everything felt right away not at all difficult.

This student had a quite unique skill in seeing patterns – a skill contributing with added value for debugging code. She constructed her code by tables with different indentations creating a pattern easy to read. If you repeat a pattern enough times, your eyes get used to how it must look like and how it must be interpreted.

This student graduated successfully in media technology with a bachelor thesis titled *Programming structure from dyslectic perspective* and a production of a website for an external customer programmed in php4 and a database in MySQL.

The Secret

What was the secret behind the successes of the new pedagogics in teaching programming that Kerstin and Christina developed? How did they reduce fear of learning how to write code and make software?

One secret, however simple it may appear, is to leave the master's desk and thoroughly learn how every individual student think, when they learn programming. Different students think differently and there is no right or wrong way to solve a programming problem. The teacher moves around, asks how, listens and supports the student's own logic.

The number of lectures was reduced in favour of group briefings, where different solutions could be discussed when the students were stuck. Several modes of learning developed by the students were highlighted.

In the group briefings the students learned from each other many ways to think and find ones way in problem solving. Later on the students saw what they did and could get closer to simpler solutions, simplify the code, more in line with masters. Acknowledging their own learning processes reduced fear, increased self-esteem and opened their eyes for possibilities in whatever the students later wanted to do in media technology applications. The students were requested to study 2 and 2.

One important aspect, when the students got stuck, was to pay attention to what the students actually had learned. They didn't see it until the teacher brought it up. More than once the teacher got the comment "I have not realized I have learned so much as I have". By focusing what the students had learnt to master, instead of on what they had not yet learnt, the students' self-esteem were increased and they were encouraged to continue their efforts to learn more.

The traditional written examinations were replaced by oral group examinations. As the teachers knew the learning process of each student in the tight tutoring, the student couldn't hide in silence. The oral examinations included a number of artful problems to be solved and explicitly explain the solution of.

Some obvious results of the development project for the programming courses were

- drastically lower drop outs of students in the media technology program
- reduced fear for and changed image of programming skills
- alternative ways of programming emerged
- the students took initiative to and started more demanding projects earlier than before.

Conclusions

The transformation approach of the pedagogics in the programming courses can be understood as situated learning with a direct link to Donna Haraway and her theories and practices in situated knowledges (Haraway 1998). Haraway's emphasize on the *"way we might*

become answerable for what we learn how to see" (Haraway, 1991) is worth bringing into the transformation process. Inspired by Haraway the implementation of her approach is an example of a concrete connection to the feminist technoscience research at campus Karlshamn, BTH.

6. Media Technology – an educational approach

In the dissertation *Media Technology in late modern time - Digital technology, aestethics and expression* (Ekdahl 2005) the foundation of the educational approach at BTH, campus Karlshamn is expressed. By translating a selection of texts from this dissertation we want to describe the development of a candidate programme in digital technology with the attempt to *highlight the culture from within.*

> *"Media technology is inherently interdisciplinary. Education and research in media technology and interaction can not only be done from a technocentric approach. Development and use of media technology requires, in addition to solid technical skills, extensive knowledge on media content, their process and design, human communication processes."*
> *Study plan for the civil engineering program at KTH*
> *www.kth.se 2000-03-10*

The transformation process is investigated within undergraduate education at BTH campus Karlshamn and how it can be a part of not only improvements within an organization but also for changing thought patterns contributing to changes in the whole system. The concept of technology is discussed and how it is situated between a mechanistic and digital paradigm and what consequences the

transition from the former to the letter will have in knowledge and learning as well as in its elongation toward a responsible technology development. The main question is how the concepts of person, knowledge and learning can and should interact in an education of digital technology to bring about a transformation of the second order, which means doing and learning something quite different and not only doing more of what is already done (Bo Ahrenfelt 2001).

The relation between Media Technology and Feminist Technoscience

The media technology undergraduate education at BTH campus Karlshamn gained legitimacy and credibility from its very start due to how it was and is related to the research area of Technoscience studies. In other words Technoscience studies was from the beginning the research underpinning of the undergraduate education.

Having this research area as a substructure means the undergraduate education programmes are carried by epistemological and knowledge building components open enough to invite the students to formulate and inspire to new research questions and research areas in digital technology. It is an issue of epistemological pluralism, which characterizes feminist technoscience research and provides a free space for media technology students to participate in change processes from within, with a critical approach, based on their own experiences.

Instead of hiding the shortcomings of how scientific objectivity is taught to students and thus refrain from describing how research is conducted in practice, Donna Haraway's understanding was used as she prefers to speak of situated knowledges. With this concept Haraway argues that knowledges always occur in the cultural, social, political, economic contexts that are time bound and that knowledges are tested and changed in action. This is not particularly surprising or controversial. But a traditional academic culture affirms unwritten laws of knowledge hierarchies, where resource allocation is dependent on gender, status and prestige. These conditions allow for a rhetoric that is not always valid in the action plan. Therefore, Haraway's concept of situated knowledges become decisively im-

portant for training in digital technology, as she exposes individuals and the interaction between them in a way that feeds both freedom and responsibility.

Media Technology - a necessary change

Media has existing or potential partners all over the world, because the need for change seems to be necessary in our time. The changes are for instance based on the following movements in the late modern time, which are also crucial for an education in digital technology.

- Contemporary changing social, economic and individual opportunities for the young generation and therefore their views of themselves and their learning.
- The focus on subject knowledge that counteracts the student's own reflections, discoveries, contestations, freedom and responsibility, while a knowledge progression over a longer period of time thereby is hampered.
- Knowledge and learning concepts are rapidly changing as a mechanistic worldview is challenged by a digital paradigm, which demonstrates that the development of and training in technology is no longer a concern only for engineering sciences.
- Technology education programs and especially so in media technology need to be developed so that prospective students, regardless of gender, find the trainings attractive and relevant.

The process of an undergraduate program - planning, development and reflection

How can an undergraduate program in media technology encounter the challenges indicated above? One choice made was to develop the program to be design-oriented and build on the concept gestaltning (in Swedish), gestaltung (in German). There is no direct translation to English of 'gestaltning'. We thus use the English word 'figuration' and 'design-oriented'.

> *"Figuration [or design] is the expression and the form (technically and aesthetically) one gives a knowledge content in order to, as strongly as possible, capture and maintain the interest of the intended recipient."*
> *Ekdahl 2005, p.155*

The content of the education plan for 2000-01 is described in course format. Courses in basic technical skills should be combined with design-oriented courses, which was vaguely defined as courses in basic scene-, image-, and sound design. There was still an intuitive feeling among the teachers that the concept design could contain something important and central for the undergraduate education. Along with reflection courses the knowledge had to be applied in project courses, which in turn would reflect relevant professional work situations by building on generation of ideas, planning, financing, implementation and a summarized reflection. In the first year curriculum there was thus only hints of a knowledge and experience progression.

Five years later, in 2005-06 curriculum of media technology was named as a design-oriented (gestaltande) *professional* education despite the risk of being interpreted as an aesthetic, artistic education. Media technology shares this risk with for instance architectural courses available at technical universities, which are also design-oriented in their basic character.

The characteristics of a design-oriented (gestaltande) professional education is perceived as the development of general and specific professional skills by combining thought and feeling in productions. Reflection has to take place both during and after completion of production through a dialogue with and feedback from supervisors.

The essence of the reflective dialogue can be summarized in the following. Design-orientated activities in a technical education are not only about searching for forms of expression, but should be based on an approach to oneself and the outside world. It is a claim that has consequences for the relationship between a mechanistic interpretation of the concept of technology and media technology examination of what a digital technology concept can contribute with.

If the design is based on an approach to the individual and the outside world, and if each expression is personal, then the technology is also part of a design. The technical and aesthetic expression in media technology is thus indivisible and inseparable. When a student, teacher or tutor understands that she or he owns and can develop her/his own technical and aesthetic expression and has the ability to communicate them, the concept of design will include the forms of

knowledge required, namely propositional knowledge, experience, familiarity, intuition and wisdom. Working with design therefore provides prerequisites for personal development among teachers, tutors and students.

The above reasoning is one of the most difficult to relate to in the dialogue between staff and students. The strong traditions developed and included in invisible conceptual repertoire of the engineering sciences, is transferred to the youth school's value culture whereby most students perceive technology as abstract theory and thus separated from its design oriented features. This in turn means that students have great difficulty to relate to technology as an expression of her/his person and so tend to become other-directed - to become dependent of interpretations of authorities and traditions. When technology is separated from the person, also the individual loses her/his own direction forward and therefore her/his responsibility and ability to understand the relationship between technology theory and its design. This eliminates also the understanding of the technology as shape and material and a knowledge content to be communicated.

One of the consequences of university education and research in digital technology is the disciplinary divisions becoming increasingly obsolete, for example division of computer science, data communications and telecommunications. These areas of knowledge are no longer core areas that will be used in various applications, but new areas of knowledge developed cutting through the established topics. The concept of technology needs to be expanded as technology and content are united by the core concept interaction. Digital technology will merge with a content that can simulate situations covering as close, unlimited communication as possible, in order for people have opportunities to spontaneously develop common conversation and ideas with one another.

Technoscientific Media Technology

Is gender equality integrated in the pedagogical approach? In order to be able to answer the question we have to be clear about what we mean with gender equality. If it is understood as 'counting heads',

the answer is no. There is only one profile of the media technology education having almost equal numbers of women and men. It is the profile of 'Digital Visual Production'. The teacher staff is consciously but slowly increasing its numbers of female staff members.

If gender equality is understood as a qualitative transformation agent in knowledge content and culture, the answer is yes referring to the R&D work of feminist technoscience. The results are both implicit and explicit. During 2014-2015 the connection between media technology undergraduate education as a professional education and media technology as a feminist technoscience education has been developed and deepened further. The students study feminist technoscience perspectives with a specific focus on posthumanistic approaches, which support the students to study and discuss the agency of technology in their design processes. This also includes the issues of accountability - for who do the matter matters and what are the realities their design work produces.

The naming of the undergraduate programs was 2014 changed from media technology to *technoscientific media technology*, which is also acknowledged by the VC of BTH. To use the concept technoscientific media technology is a strong sign of even more solid links between the research and undergraduate programs as well as giving the department and BTH an added value in the national and international context of media technology.

7. A Norm-critical Game Culture

A norm-critical game culture was a study about how norms and power discriminates innovation processes in game development and ultimately the game culture. The focus was on University undergraduate students and their thoughts and behaviour on innovation, gender and games. The study was conducted by Linda Paxling, PhD student as well as Project Coordinator and Elin Hallgren, consultant and seminar leader. Pirjo Elovaara and Lena Trojer supported the project as mentors.

Purpose and goals

The purpose was to identify norms and attitudes of future game developers, increase the knowledge of a norm-critical perspective in the gaming industry and experiment with the concept games in collaboration with the industry and the public sector. The pilot study was based on the project participants being the catalyzing assemblages.

The aims were:

- to develop knowledge on game development and the gaming industry.
- to develop skills and methods on how norm-critical perspectives becomes an action in the gaming industry.
- to organize a hackathon focusing on norms and games for change and innovation.

Why is it important to question the norms of games?

The gaming industry is an industry that is growing fast. According to the Game Developer Index 2014 Swedish game developers acquired 6.55 billion in 2013 and employment grew by 29 per cent. There are currently few women studying game development in Sweden, 12% in 2010 despite the fact that there has been a doubling of the number of game programs between 2006-2011 (Game Educators index 2011). Regarding the labour market, it is reported that only 16% of those working in the gaming industry are women (Game Developer Index 2014). Although there are reports of improvements in terms of achieving an equal distribution between men and women, there seems to be some time before this is achieved in education, business, boards and number of start-ups run by women.

A closer look at the games themselves often lack a diversity of characters, where the norm is often a heterosexual white man. This does not reflect, however, the player. Reports indicate that there are differences in the game culture regarding sex but that there is a relatively equal distribution between men and women among the gamers and with the frequency of gaming (see for instance the Swedish reports; Unga och Medier 2012-2013 and Världen som spelplan- gränsöverskridande i onlinespelkulturen)

There is a long research tradition in Sweden on gender and technology and it is possible to see parallels from the experience of issues in technology and IT that we see in the games - see Trojer, (2002) on gender studies in Technoscience, Olofsdotter-Bergstrom (2009) on SuperMarit, Fröberg (2010) on the high school technology programs. There are several public inquiries about

technology, IT and gender, see KTH (2006) on gender equality action plans in the IT field, SOU 2010: 99 Council for Gender Equality in school or Growth Analysis (2012), Follow-up Action Plan Equality IT development for increased growth.

How do we want to change the game culture?

We began with the questions:

How will games look like in the future?

Who will make the games?

Who will play the games?

During three seminars we discussed issues based on three themes, Education and research, business and industry and future uses. The students shared many insights into how they perceive today's game industry, both in terms of education and labour, which features in the game that are perceived problematic and how they see the future. Some students found it difficult to think of situations in their education where there were conversations about innovation, norms, gender or computer games, others had problems with considering themselves as active participants in their environment, and explained that the content and analysis should come from someone other than themselves. It seemed to be a certain indoctrinated way of learning and performing certain tasks, which caused problems when this was challenged by us, project managers.

We used the method participatory action research for the project, which require an active participation from all participants. The method can be "defined as systematic inquiry, with the collaboration of those affected by the issue being studied, for purposes of education and taking action or effecting change." (Green et al 2003, p. 419). There was a difference in how this was perceived by students and participants in hackathon. Some of the students were marked by a traditional knowledge hierarchy, where knowledge should come from someone else. For us, the project managers, it led to having to do a balancing act between guided techniques and more open processes. Participants in the hackathon were much more open to this the participatory action method and understood the opportunity of their own participation.

Long way to go if nothing is done

The skewed distribution between men and women among the country's gaming education programmes and businesses leads to a skewed distribution of gaming culture and the gaming industry. Today, there are some gender divided statistics in the gaming industry (see Game Developer Index 2011, Dataspelsbranchen) but there lack a comprehensive overview regarding education, entrepreneurship, research and distribution of resources. Earlier efforts like SuperMarit at Gotland University, has been described as successful, but there haven't been any resources to push it any further. Today there are smaller network investments, but they suffice primarily to "drawing attention to the education" rather than to actually influence the content of the industry. The women we've talked to describe the issue that they are the ones pressing the matter at hand, voluntary and without support from management or industry networks.

Discrimination in the innovation process

Before the study discussions with different groups were held to identify possible approaches. The discussions showed examples of shortcomings in how games should be used. Are computer games for entertainment or education? This results in a lack of innovative products and services. The collection of statistics and reports have also identified several gaps in both education and research, where are the women in the companies (are they developers or administrators), ownership, resources from public funds (where does the money go) as well as gaps in the statistics of the player itself (gender, age, gaming console, genre, time, location). These shortcomings indicate there is a clear risk of discrimination in the innovation process.

The importance of removing hierarchies

If we want to change the game culture, we must also be willing to change ourselves. We as project managers have an experience in matters relating to norms and gender. This has been the basis for our analysis. We removed the concept of experts (expert gamer, gender expert, scientific experts, etc.) and provided an arena where

everyone could be game developers with the result that we could all go into the field with new eyes. This method led the process forward. One of the students expressed the freedom that this approach meant: *"finally, there is room to think completely without lectures from so-called expert gamers or gender experts"*.

Is it possible to get a norm-critical game culture?

Yes! On a short term, this project has generated benefits by identifying gaps in education, statistics and initiatives. The project has also found opportunities. The hackathon experimented with norm-critical innovation processes in collaboration between academia, industry and the public sector. The effects of the project and its methods are possible to see in how all participants act and relate to norm-critical perspectives in the contexts where games are discussed and developed.

8. Epilogue 5 Voices

Thoughts about gender equality at a technical university

Pirjo

When I was initially employed at BTH 1995 I became a member of the Gender equality committee, and was very interested to work for change within the university; to make us aware of the structural differences but also to discuss the educational programs and research It was extremely hard work, in many ways. In order to wake interest and make the gender equality questions relevant within the BTH context we experimented with a variety of forms: seminars, meetings, events, invited external lecturers, but this did not work, we did not succeed in our efforts to make gender equality questions important and relevant. I reflected a lot of the not-successful results: Was our approach anyway too open, i.e. gender equality on a general level and thus too far away from the interests at a technical university? Was our approach not focusing on the actual context? However, we reached one concrete goal: the instructions for the budget proposal said that the proposals should include a notion of how the

budget would affect both female and male employees. But when the instructions travelled further to the departments the effect was minimal. Most of the departments did not follow the instructions and there were no explicit consequences of this either. Afterwards I also realised that the committee, inclusive myself, was too eager and restricted to think gender equality as a quantitative question; how to add women and how to increase the number of women.

I left the committee and changed the direction of my work. Today I am convinced that the quantitative focus is not the main interest for me. I think that we in a much higher degree must work with matters connected to epistemological issues. How both things and people get their meaning in contexts and how our theoretical approaches and methods can become the very issue for feminist technoscientific research, and thus also for undergraduate educational programs. So I join Sandra Harding´s invitation to move from gender (as a static unit) question in science to the science question in feminism. However, I totally support the political activities for change but as a scholar my contribution comes for my research and teaching field.

Lena

In any academic organisation facts and statistics are very important. Persons in charge and in decision-making positions seem to have a different view concerning gender equality – not believing an actual situation. When these people see the statistics, it is at least a start for them to see and accept facts and hopefully start acting.

For gender equality work at academic organisations, and especially so at technical universities, there are 3 arguments for why this work is important.

Argument 1. Equal rights.

As no one disagrees with this argument, it is losing potentials for change, for transformation.

Argument 2. Quality.

When it comes to this argument, you have to be very relevant and contextualized. At technical faculties there is a number of convinc-

ing studies and published work giving examples of what can make up qualitative aspects. Within computer science and software the qualitative aspects can be followed deep down in coding i.e. for object-oriented programming built on defining reality in objects. A too limited representation of persons (women and men) will diminish the quality of reality definitions.

Argument 3. Culture.

At a young university like BTH we might have a chance to develop an equality fostering culture, since the traditional, academic culture is not yet sucked into the walls. The chance depends on the staff entering BTH. Everyone has a packsack of one's former university culture not the least the culture of Lund University.

Linda

It will take time before gender equality becomes an integrated practice at a technical faculty. I did my undergraduate studies at a social science department and the gender discourse was quite explicit there. It was part of an everyday practice to talk, write and argue about gender equality, or rather inequality. It was an important aspect of the learning process to think and act critically about the theories and actions enmeshed with society and ourselves.

My experiences with a technical faculty are quite different. Here you are met with resistance, silence and fatigue. Voices from within the University believe that we have reached gender equality and that we no longer need to focus on this issue. These views reflect the importance of a culture change and the urgent need of prioritizing courses on gender equality on all levels within the University. Our results from the gender budgeting analysis is but one example that show inequality at our faculty.

A culture change is also needed in order to create a safer working environment. Gender stereotyping needs to be addressed and challenged by leading managers. When more staff acknowledge that their views affect their workplace, their research and their student's practices then a much needed culture change can begin. For this to happen the management needs to realize that gender equality is a necessity for a progressive and democratic faculty.

Kerstin

My background consists of one foot in education and the other in computer science.

It becomes clear that we have a long way to go before we as men and women are equally respected and that our experience is deemed equal. We are far from the equality that we fought and still constantly have to fight for that we achieve.

The traditional technical world has much to gain from greater use of women's experiences. We need to be conscious and make reflections about the choices we all do and what these mean for increasing gender equality and breaking / or maintaining old structures, which exist both within BTH as well as in society as a whole. Women's experiences belong to "The Real World" and are necessary for taking into account everyone's realities.

My experiences of feminist technoscience at BTH can show the way to a new way of looking at how knowledge is created.

Christina

With a background in engineering, I have many years of experience as a lecturer in computer science/computer engineering from several Swedish universities. Being a woman in these environments can still be hard, especially if one is not able or do not want to conform to existing culture and disciplinary traditions. My feeling of not belonging, of being "wrong", grew. So I gradually became interested and engaged in gender equality issues. My experiences in this work are similar to Pirjo's, it is difficult to make gender equality important in traditional technical departments. Computer science has few female students, and there is an interest in attracting and retaining women in CS, but this interest mostly stays on the surface, and does not involve changing the discipline. The (unsuccessful) efforts I see today are the same as they have been for many years: trying to convince female students that CS is interesting. It seems very difficult to accomplish changes at a deeper level.

So is there no hope for change? I have come to believe that projects aiming at transforming existing educations and institutional

cultures are very difficult. They require constantly ongoing efforts. Instead, I believe that change can be brought about by making and creating new environments, educations, departments. Places where people from different backgrounds can learn to cooperate and understand each other with joint efforts in for example education and research. Places open for epistemologically new and different approaches. Places where those who choose to stay in their traditional environments can get strength and a supportive community. Places like Technoscience Studies.

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