Gender Research as Knowledge Resource in Technology and Engineering

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ABSTRACT
When bringing forward discussions of gender, we tend to go into a practice of counting heads i.e. how many women are present in which functions, especially in sectors of technology and engineering. Rarely are gender issues seen as knowledge and technology generating. In the paper two cases are introduced, one from Uganda and one from Sweden, in order to illustrate what kind of value addition certain academic activities can have. The value addition in more concrete terms evaluates the substantial contribution by an ICT/GIS Centre in Arua District in Uganda as well as a new university campus at a technical university in Sweden. Epistemological comments are presented on techno-scientific gender research, fostering and trying to advance our understanding of knowledge production in technology and engineering.

Keywords: Engineering; Gender Research; Technology; Technoscience; Triple Helix

1.0 INTRODUCTION

When bringing forward discussions of gender, we tend to go into the practice of counting heads i.e. how many women are present in which functions, especially in sectors of technology and engineering. Rarely are gender issues seen as knowledge and technology generating.

The ambitions of gender research to make itself scientifically relevant within specific areas have found expression in many different ways in the last few decades in both theory and methodology (Trojer *et al*. 2000). Within fields of knowledge related to technoscience, gender research or feminist technoscience has led to the spotlight being turned on the basic epistemological values of technoscience. Gender research participates in interventions within technology policy spheres and within the very development of technology. (e.g. Haraway 1997, Gulbrandsen 2002).

This paper brings forward two cases - one from Uganda and another from Sweden - in order to comment on vital concepts and understandings in dynamic knowledge fields like technology.

2.0 POSITION COMMENT

Every text is interpreted by some kind of perspective lenses. This position comment is meant to tune in the reader's lenses somewhat towards the authors'.

The author coming from Sweden is situated at a technical university, Blekinge Institute of Technology (BTH), which is one of the very few profiled universities in Sweden. The profile is applied ICT (Information and Communication Technology) and innovation for sustainable growth. This profile is based on close collaboration between university, industry and government, what is termed as Triple helix collaboration (Leydesdorff & Etzkowitz, 2001). Epistemologically, the same author is situated in feminist technoscience, an internationally established academic field of gender research. The latter is closely linked to the

understandings of knowledge generating processes to be distributed as described in the concept of mode 2 (Nowotny *et al*. 2001).

One of the main concerns in our academic work is encountering the complex realities in the research we carry out. We do not believe in an ivory tower situation for any university. This is easier to say than to practice. But working in faculties of engineering and technology brings us closer to practices, where it is possible to learn about complexities. Our concern is also interacting with young people and their learning processes in higher education and research. Technology is an extremely dynamic sector and we have to acknowledge experience gaps between generations, which are potentials for development and not problems. A third important concern is to interact with our cooperation partners in public as well as in private sector.

We agree with those who see Science and Society to be subject to the same driving forces of new economic rationalities pervading globally and to be actors generating uncertainties and risks (Beck 1996). We notice transformation of time and space, which not the least is an impact of ICT. One of our almost daily experiences is the increasing demand for self organizing capacity for our sustenance, including public universities.

The research division - Technoscience Studies at BTH - applies gender research perspectives to the development of a complex and multi-faceted understanding of information and communication technology as techniques producing realities and the predominant transformations which result.

3.0 **CONCEPT COMMENTS**

As mentioned in the introduction, gender issues are rarely comprehended as knowledge and technology generating. The gender equality in a quantitative manner is the dominant perception especially in disciplines like technology and engineering. Gender equality and gender research are NOT the same BUT equally important.

Gender equality means equal representation, rights and conditions for women and men. Gender research means development of scientific qualifications out of specific epistemological, theoretical and methodological perspectives. Gender research has qualitative goals, which hopefully lead to quantitative impacts. We use gender research and feminist research synonymously (Trojer 2002).

The first PhD program in gender research in Sweden was established at a technical university and in faculty of engineering science in 1993 (Trojer 2002). The importance of Swedish governmental policy here must not be neglected. This achievement was preceded by transformation and development initiatives at Swedish universities for almost 2 decades characterized by going from the gender equality question, over the woman question (like in sociology focusing women's situation) to the science question (most relevant for gender research in natural science and technology). There are no simple, automatic links between these three foci and they run more parallel than sequential.

Another concept finding relevance in technoscientific gender research is mode 2. This concept is bringing a clearer awareness of the epistemological issues in engineering, which is mostly neglected or taken for granted and thus not reflected upon in the dominant paradigm of our traditional universities. Mode 2 describing our practice more than our academic understanding in engineering sciences was brought up in the well known book "The New Production of Knowledge" (Gibbons *et al*. 1994), a book that rocked the paradigmatic ground for a number of established professors in Sweden and elsewhere. The critique from mainly academia is in itself a sign of hitting the core of academic knowledge production, which is supposed to be built on enquiry.

Mode 1 is our traditional understanding of academic research characterized by disciplinarity, internally-driven taxonomy of disciplines, neutrality, objectivity, hegemony of theoretical or experimental science, autonomy of scientists and their host institutions (the universities), sharp divide of basic and applied research, cumulative knowledge development, absolute truths and context of discovery.

Mode 2 is characterized by context of application and implication, trans-disciplinarity, diversity of sites of knowledge production, highly reflexive, accountability, novel forms of quality control, socially robust knowledge.

One of the front persons of mode 2, Michael Gibbons, explained in an interview at the conference HSS (Universities and Society in Collaboration), Ronneby, May 2003, that mode 2 processes have always been the case for universities since their beginning. Mode 1, he emphasized, started to develop during the Scientific Revolution (Merchant 1980) and is a specialized part of mode 2. As a consequence perspectives of mode 1 and mode 2 are there to stay and the question is not to choose one mode before the other. The question is to use the most relevant mode for knowledge production in the specific situations and contexts.

4.0 PRACTICAL RESULTS
In the following section we will present two examples on what kind of value addition certain academic, mode 2 activities can have starting in gender related issue. One example comes from Uganda and another form Sweden.

4.1 Case in Uganda
A researcher at Faculty of Technology (FoT), Makerere University (MAK), Dr Peter Okidi Lating, started a research study in 2004 out of the questions why there were so few female students at Faculty of Technology at his university (and elsewhere in the world) and why so few students at MAK coming from secondary schools in rural areas. Over 90% of the few female engineering students were at that time from the 'elite' and advantaged urban schools located in Kampala and its surrounding districts of Mukono and Wakiso. The two research questions were linked in the study and with an explicit dimension of gender issues, obviously in the more quantitative gender equality notion but implicitly in a qualitative sense especially for knowledge production at a technical faculty.

The site of study became Arua - a remote, poor and insecure Ugandan rural district, 500 kilometers from Kampala. Two girls' secondary schools were chosen in the periphery of Arua town. Hybrid e-learning tools were developed and implemented. Hybrid e-learning in the context of the project means e-learning, where the main course delivery platform is interactive multimedia CD-ROM and where face-to-face traditional classroom teaching remains. The development part and the implementation of the project took place in a kind of parallel process including setting up an ICT centre in the middle of Arua town.

The main reason for an ICT centre (which later on became the ICT/GIS Research Centre) in the project was the financial situation in both secondary schools. Resources for the operational costs of sustaining Internet connectivity were not available. A decision was made to deliver content in CD ROM format to the schools but set up an ICT Centre with VSAT Internet connectivity within the vicinity of the two schools.

To anchor the whole project in its starting phase, Lating approached the local and district Government of Arua and presented the project including the interest of FoT to develop an ICT centre in Arua with the facilities of internet connectivity. The response from the Arua Government was very positive. They understood the potentials for the town and district and showed that in practice. They provided premises for the centre in an old court house building, which they quickly repaired and upgraded its security facilities. FoT, with financial support from Sida/SAREC (the Swedish International Development Cooperation Agency), equipped

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the Centre. Furthermore, Lating approached the business community of Arua and they agreed to use the services at the Centre to make it sustainable. Lating was thus practicing a Triple helix process in the specific context of a rural district of Uganda.

The whole project is presented in detail in Lating (2009). In this paper we focus on some gender issues and their impacts.

In spite of the different approaches of the respective headmistresses of the two secondary schools - not so much to the project as such but to the girl students participating in the project - the girl-students were enthusiastic. A number of notable situations happened with the girl-students and their teachers during the project. These stories must be written in another paper (or novel). As a very concrete result the analysis of the research study showed 41% of the students in the final year (A-level) passed and were eligible for university admission compared to almost 0% before without the e-learning tools for girls born and living in Arua. And this result was shown after only six months of the use of these tools by the girl students and their teachers.

The decision to put up an ICT centre had a huge impact of not only the town and its surrounding district but also to municipalities on the other side of the nearby border with the Democratic Republic of Congo and Sudan. What started as a gender related project eventually by 2007 was involving the following stakeholders in the use of the ICT centre:

District and local government officials
Regional District Police Commander's Office; District Police Commander's Office; Chief Administrative Officer's Office; District Medical Officer's Office; District Forestry Office; Resident District State Attorney's Office; District Information Office; District Engineer's Office.

Schools
Muni Girls Secondary School; Ediofe Girls Secondary School; Mvara Secondary School; Arua Public Secondary School; Arua Public Primary School; Uganda Christian University, Arua Campus; Arua Vocational Training School; Arua Core Primary Teacher's College; St. Joseph's College Ombachi and Anyafio Role Model Secondary School.

Hospitals
Arua Hospital and Maracha Hospital.

Other Governmental Institutions
National Social Security Fund (NSSF) and Northern Uganda Social Action Fund (NUSAF)

Business sector
The District Chamber of Commerce, West Nile Rural Electrification Company (WENRECo); Uganda Breweries; Private Sector Initiative (PSI) Uganda; Sumandura Construction Works; Boniface Television Networks; Nile Fm / radio station; Arua One FM radio station; Copcoot Uganda; Westnile Distilleries; Heritage Gardens- hotels business; Multitech Uganda- ICT training business; Kuluva Hospital and Marie Stopes Uganda –Reproductive health provider.

Non-Governmental Organisations and Community Based Organisations
Netherlands Development Organisation (SNV) Uganda; United Nations High Commission for Refugees; Cream Uganda (Community Based Organization); PAD (Community Based Organization); PRAFOD (Community Based Organization); CAFECC ((A Sudanese Community Based Organization); World Vision Uganda; WENDWOA (A women organization helping widows and helpless children); NSEA / Needs Service Education Agency.

Others
Students doing online courses in and outside Uganda; visitors to Arua and those in transit to Southern Sudan and Eastern Democratic Republic of Congo; travel agents; students from schools outside Arua District mostly during school vacations; community workers and the indigenous people mostly using the Internet for communication with their relatives and friends in and outside Uganda.

The Centre trained students from West Nile Districts, South Sudan and Democratic Republic of Congo. District leaders from other Districts in West Nile (Koboko, Yumbe, Nebbi, Adjumani, Moyo) came for the training on weekends.

The number of stakeholders is impressive and quite unique compared to a Swedish regional context. This is a strong sign from the stakeholders for an acknowledged relevance of the e-learning project and its impact in a place like Arua District (Lating *et al.* 2007)

In 2010 the Uganda Government decided to establish a new university in Arua - West Nile University. The ICT/GIS Research Centre is one of the cornerstones for starting the development process of the university, a great result of Lating's R&D project.

4.2 Case in Sweden
The Swedish case is embedded in the development of a new university campus at the technical university BTH. Starting a new campus was a result of negotiations between the leadership of the university and the local Government of the town, where the campus was to be located. At the same time an innovation node or innovation system called NetPort was established. NetPort became later on an organization co-owned by the university, the local Government and the business sector of the three focus areas chosen. The development of the campus and of Net Port started in the year 2000.

Developing a new campus for a university of technology in a Triple helix context needs at least 4 starting conditions, namely
1. undergraduate students
2. graduate students
3. epistemological acknowledgement of mode 2
4. tolerance towards resistance always appearing in development processes, especially internal.

In the year 2000 the Vice Chancellor of BTH (later on Director General of VINNOVA, The Swedish Governmental Agency for Innovation Systems) approved 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 fulfill 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 Ahrenfeltd (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

sucking. Without resistance the possibilities to focus the own direction of the development work is obstructed. The sectors mobilizing the strongest resistance are often sectors where transformation work is mostly needed. In addition, resistance helps to detail and clarify what kind of development and transformation terms you need and in addition fosters dialogue.

After ten years the university campus is firmly established mainly thanks to the sustainability strategy of NetPort and an understanding of Triple Helix collaboration to be dynamic, to pass different phases during expansion and the necessity to be nurtured all the time in continuous dialogues.

Why then gender research in a university campus formation, one may ask. Some answers are to be found in the theoretical and methodological work of the actual technoscientific gender research in

- expanding the knowledge frames and practices for technology development in increasingly complex realities;
- opening up preferential rights of interpretation in selections of e.g. standards, which always are reality producing activities;
- emphasizing the importance of power relations and their impacts, including complex understanding of gender structures;
- process-oriented development through a broader understanding of transformation practices;
- enforcement and integration of situated knowledge and technology development;
- developing epistemological infrastructures relevant to a society heavily dependent on research and technology; and
- establishing new arenas for developing understanding of relations between research, political sector and industry.

5.0 **CONCLUDING DISCUSSIONS**
The summarizing discussion includes short epistemological comments on the cases presented as well as reflections on how technoscientific gender research is fostering and trying to advance our understanding of knowledge production in technology and engineering.

5.1 Reality Production
The Uganda case presented above elucidates how boundaries between society and research are not straightforward and clear, that goes for all our civilisations increasingly depending on research and knowledge. Nowadays it is claimed that research and society are co-produced or co-evolve (Nowotny *et al.* 2001), which is a long way from the simple, linear understanding of this relationship that has dominated research policy hitherto. It is in the field of technoscience (like information and communication technology, bio- and gene-technology and material technology) that scientists are most clearly pushing the boundaries between science and society, research and politics, thereby illuminating the obsolescence of a linear understanding (Gulbrandsen 2004). A typical characteristic of technoscience is the reverse logic of the fact that knowledge must be applied in order for it to be tested. A classic example is reproduction technology, from in-vitro fertilisation to cloning.

Increasingly open systems for knowledge production require a focus on the direct reality-producing effects of research – its context of implication (Nowotny *et al.* 2001). According to Donna Haraway (1997, p. 68) there is neither time nor space to develop research's relations with society "… after all the serious epistemological action is over". Neither sustainability nor other values that we would like to realise can be secured retrospectively. Our technoscientific research is positioning its projects and work to promote more complex and integrated understandings of the relationship between research and society in this grey area that Nowotny *et al.* (2001) ascribe to a dedifferentiation of the social spheres of modernity.

5.2 Situated Knowledges
The term 'situated knowledges' was coined by Donna Haraway as part of her epistemological work to provide alternatives to "… developing at home that voice of entitlement, the voice of control, that accompanies the conquest of empires far from home". For Haraway, all knowledge is local; it is historically and culturally situated. It is problematic to argue for a watertight bulkhead between the researcher as a subject and the research object, between observing and changing, and between research and politics. The researcher is regarded as an active participant in the research process, she/he generates and organises knowledge in an ongoing interaction with the reality she/he is researching. This notion of situated knowledge constitutes a vital part of the epistemological base for the case in Uganda as well as in Sweden presented.

Situated knowledge is a cornerstone concept in feminist techno-science (Haraway 1988, 1997) and it is also fostering our understanding of innovation processes. The significance of the local, the situated, is expressed by Reijo Miettinen (2002) in the following: "... innovation is about adapting to changing circumstances and making new things in new ways. New ways to do things always emerge locally".

5.3 Learning Processes
No-one disputes that dialogue and participant-based procedures are gaining a footing in social sciences. However, institutional systems are full of fuzzy areas and things between the lines that are difficult to grasp, activate and study (Haraway 1997, Argyris 1991). To work in processes including culturally different institutional systems like government, academia, and the private sector amplifies these challenges. The contributions towards a functional and sustainable system, that the cases illustrate, underline conditions required by good learning environments and learning processes. The open minds of the actors involved, a jointly identified goal and presence of the actors in the context of application show it is possible to learn and co-evolve.

6.0 ACKNOWLEDGEMENT

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