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Document Version:
Author accepted manuscript (postprint)

Citation for published version:

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Gender equity in Higher Education: Why and how?

A case study of gender issues in a science faculty

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Abstract. At a time when more and more natural science subjects are attracting an increasing number of women (chemistry for example) physics remains a male stronghold. It is not so easy to understand this phenomenon or the anomaly that over representation of males in physics faculties is more likely to occur in countries known for their attempts at equalising opportunity for women. Sweden for example has a parliament in which 40% of its members are women and yet the average percentage of women lecturers in physics faculties is about half of that. In Sweden today women professors in physics (both appointed and promoted) represent a 11% of the total professorial staff. In this paper we report on a qualitative case study of gender equity in a large physics faculty in a Swedish University. In order to locate our study in a more general social and political context we look at Swedish legislation that seeks to equalise opportunities for women in higher education. The rest of the study focuses on a brief review of research in the area of gender issues in higher education and an analysis of interviews with three women in physics: one a professor, one a lecturer and the third a PhD student. The analysis discusses why the current disproportion exists, if it is a good or bad thing for physics and physicists and how one might rectify any perceived problems in terms or gender relations and gender equity.

Keywords: Gender equity, engineering education, physics.

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**Introduction**

Our study was inspired in part by Belenky, Clinch, Goldberger and Tarule’s classic study *Women’s Ways of Knowing.* Like these researchers we grounded our case study in a constructivist research paradigm and made use of semi structured interviews. The type of interviews we used are inspired by the approach that William Perry employed, that is ‘an open and leisurely interview that establishes rapport and allows presuppositions and frames of reference of the interviewee to emerge’ (Belenky et alia. 1997). The steps we followed in carrying out this study consisted of a literature search in the area, the collection of existing statistical data, a survey of current Swedish legislation and extended interviews with three women at different stages of their careers in physics. Data from the interviews were analysed and a number of conclusions reached. One motivation for the study was that our survey of recent literature suggested the need for gender studies that focus on particular faculties within technical universities.

**Physics staff at the targeted university**

The universities in this study are located in Gothenburg in Sweden. Until a recent reorganisation Chalmers University of Technology (CTH) and Gothenburg University (GU) had combined their resources to make up a single faculty that served students from both institutions. The table below shows permanent positions, made up of professors, senior researchers, associate professors and lecturers; and non-permanent positions, made up of PhD students, guest researchers and assistant
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professors. Assistant professors are usually appointed for two or three year terms with the chance to be reappointed. A tenured track is now being established for this group of academics. In Sweden students doctoral students are in fact part time staff members. They sign a contract (usually for up to four years) and are required to teach part time. In the Physics department in this study there are about 25% female doctoral students which is about the average gender ratio for doctoral students at CTH. The number of permanent staff who are females is lower and significantly lower when it comes to professorial staff 11% (Jämstälhetsplan 2003-05).

Table 1: Statistics of gender distribution in academic positions in physics at CTH/GU.

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
<th>Women</th>
<th>Women (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor (Appointed)</td>
<td>32</td>
<td>4</td>
<td>13%</td>
</tr>
<tr>
<td>Professor (Promoted)</td>
<td>11</td>
<td>1</td>
<td>9%</td>
</tr>
<tr>
<td>Senior Researcher</td>
<td>17</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>8</td>
<td>1</td>
<td>13%</td>
</tr>
<tr>
<td>Lecturer</td>
<td>21</td>
<td>4</td>
<td>19%</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>21</td>
<td>4</td>
<td>19%</td>
</tr>
<tr>
<td>Guest Researcher</td>
<td>19</td>
<td>4</td>
<td>21%</td>
</tr>
<tr>
<td>Total permanent staff</td>
<td>110</td>
<td>14</td>
<td>13%</td>
</tr>
<tr>
<td>PhD Students</td>
<td>137</td>
<td>34</td>
<td>25%</td>
</tr>
</tbody>
</table>
What stands out in the table above is the absence of women among senior researchers. These, along with the professors, are the people who win the grants that support research groups in the faculty. Another interesting statistic is the number of males and females promoted to professor. Sweden has done away with an earlier system of state appointed professors and it would be instructive to see if there are significant gender discrepancies in the promotion professors since the policy was introduced in 1999. A trend that can be discerned in the full statistics is that the percentage of women is generally higher in experimental than in theoretical physics and in the ‘softer’ branches related to biology and chemistry. In Chemical Physics 11 out of the 22 PhD students are women and among the scientific staff 3 out of 14, or 20% are women. Perhaps role models have an effect on recruiting female PhDs with female staff attracting female students. The number of women in the permanent staff category and among PhD students has increased during the past decade. The respective numbers were 10% (permanent staff) and 16% (PhD) in 1995, and 12% and 23% in 1999. According to the Chalmers equal opportunity plan (2005) there are, on average, no significant salary differences between male and female scientific personnel.

**Politics: goals and measures**

The Swedish Equal Opportunities legislation which defines the official Swedish policy concerning gender equality specifies that if one sex is under represented, the employer should ‘especially endeavour to recruit applicants of the underrepresented sex and shall seek a gradual increase in the proportion of employees of that sex’. In this context, the law allows for ‘positive discrimination’, that is, favouring job seekers of the underrepresented sex. It also recommends that employers prepare an annual action plan for their equality and equal pay initiatives. The
Swedish Equal Opportunities Act forms the basis of efforts to implement gender equality within the natural sciences at CTH and GU. The current plan of action for the faculties of natural science includes the appointment of equal opportunities ombudsmen, equal representation on committees, consciousness raising seminars and the active appointment of female staff. The long-term goal is 35% women among professors, associate professors and assistant professors. Among the new scientific personnel hired in the coming 3-year period, at least 40% should be women. In compliance with these rules, the Physics Faculty has appointed an equal opportunities ombudsman and a working group. Their work, the local plan of action and all relevant documents are presented on a special web page (Physics Faculty Plan of Action 2003-2005). The long-term plan for the Physics Faculty also emphasises recruitment. The plan proposes: at least 40% female students at undergraduate level, balancing technical (male dominated) and administrative (female dominated) personnel by active recruitment and having at least one woman on each Ph.D. committee. As the figures above show the first two aims are a long way from becoming reality.

**Underlying assumptions**

What underlying assumptions are these political measures based on? The most fundamental assumption, both at government level and university level is that women and men are different. A common argument in the literature is that since women have different knowledge, background, behaviour, and ways of thinking an increase in the number of women will improve the quality and diversity of academic research and teaching. The assumption of fundamental difference is obvious in physiological terms. Men and women are biologically different. There is also considerable research that argues for differences in terms of the effects of that biology and the
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way that males and females are socially conditioned (Thorne and Henley, 1983; Gilligan, 1982). The differences that result from such conditioning is usually seen to be negative for girls and women. Belenky et alia quote a large amount of research on upbringing and schooling that demonstrates that because of underlying attitudes and sex roles girls and women have more difficulty in asserting their authority; considering themselves as authorities; expressing themselves in public; gaining respect for their minds and ideas; and fully utilising their talents in the world of work (Belenky et alia, 1997).

This might explain why the 25% of doctoral students in Physics do not become 25% of the lecturers and professors in that discipline, although it would take a lot of rigorous research to prove this. Legislators, academic leaders and equal opportunity committees tend argue that women bring a different perspective to a male dominated workplace, a fresh way of looking at things and perhaps a more varied way of carrying out the various academic tasks expected of teachers and researchers in the hard sciences. It can be argued that the minority of women who succeed in the hard sciences within academia are not at all different in terms of academic knowledge, scientific background, research skills, publication record, academic thinking and scholarly behaviour. This is the basis of their success. They fit the norm.

**Qualitative versus quantitative changes**

The equal opportunities policy at CTH and GU has been analysed and criticized in a paper by Mark (2000). Mark makes a fundamental distinction between *quantitative* and *qualitative* equal opportunity work. In the quantitative approach one simply aims at recruiting more women in
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The disparity in numbers between male and female physics professors is undoubtedly due an earlier domination of the subject at all levels by men. The time lag factor partly explains why today females occupy 11% of the professorial positions when in fact 25% of doctoral students at CTH/GU are female. But is the discrepancy also due to conditions that attach to a chair in physics. Professors are expected to network with bosses in industry (mainly male), elicit funds from granting bodies run for the most part by men, attend large numbers of conferences in various parts of the world where most of the delegates are men, lead a research school and manage, if not teach, in the undergraduate and postgraduate programs. The norm in this case suits a man who has come to expect his partner to look after domestic routines and emergencies. It may not suit a woman who is still expected by society to be a good mother and housewife.
In this section we examine many of the issues above from the female physicist’s perspective. The discussion is based on interviews with three female researchers at the section of physics and engineering physics at CTH/GU. One is a PhD student, the second is a recently appointed lecturer and the third is a full professor. The questions in the interview schedule were divided into three parts. In the first part we asked our informants about their personal experience as physicists, in the second about their attitudes to gender equity and in the third why they thought gender balance was so uneven in Swedish physics. Many of the questions concerning personal experience were based on general ideas expressed in the book *Women’s Ways of Knowing* by Belenky et alia (1997). One of the findings of Belenky and her co-authors is that many women, both inside and outside the academic world, lack confidence in themselves as thinkers. Achievement by no means guarantees an increase in self-esteem; in fact, highly competent girls and women are the ones who are especially likely to underestimate their abilities. Moreover, it is not uncommon that they feel that their success and achievements were undeserved or pure luck. Our interviews with CTH/GU physicists seem to confirm this. All three stated that they had experienced self-doubts and low self-esteem. The PhD student in theoretical physics, said her self-confidence is very low, in particular concerning mathematical/abstract skills. She suspects that she was taken on as a PhD student partly because she is a woman. Notably, her self-confidence was much stronger in high school. The professor despite her success, experienced similar self-doubts earlier on in her career; she felt that some of her success was lucky and undeserved, and feared that she would not be able to live up to her colleagues’ expectations when
she was offered a postdoctoral position abroad. However, her self-confidence has grown stronger over the years.

Concerning the difference between the genders, both the PhD and the professor believed that male physicists appear to have stronger self-confidence than female ones. When they do feel insecure about their skills, they tend not to show it. The lecturer who used to feel very confident during her undergraduate and Masters studies in the USA, experienced a drastic reduction in self-confidence after she moved to Sweden to do her PhD. She is still struggling with this problem even though she has finished her studies and has a permanent appointment. As one of the possible reasons that she gives for this is too much undeserved success: She felt her career has been ‘too easy’, that she never had to struggle or compete to get positions; she always got pushed forward because she is a woman. Another reason given for the decrease in self-confidence was the CTH culture and power structure. Our informant felt it is more hierarchical and less transparent than in the U.S., with too much lobbying, networking and decision making behind closed doors. She often feels that she is excluded from the process.

The tendency of women to lack confidence in themselves as thinkers poses a challenge and responsibility to all university physics teachers. Belenky et alia point out the importance of teachers revealing the ‘imperfect process of their thinking’. In other words, it is important to help students realize that the teacher is not omnipotent, and that his/her way of learning and solving problems is actually quite similar to that of the students. Women often experience this ‘revelation’ as a powerful learning experience and a boost to their self-confidence. Moreover, for female students, it is motivating to see other women teach and succeed in solving problems.
Motivation is a key element in teaching and learning (Biggs, 1999) but particularly important for women in the ‘hard sciences’.

The issue of role models was taken up in our interviews. Both the PhD student and the lecturer mentioned very supportive and encouraging parents with a science background as one of the main motivations for going into science (although, at times, they both felt that their parents’ expectations put too much pressure on them). The lecturer was also strongly influenced by a female science teacher in school. This person acted as an important role model in several ways – being an excellent and enthusiastic teacher, informal and down-to-earth, and with admirable personal strength. The professor, on the other hand, had non-academic parents who were supportive but never particularly encouraged her to study science. Neither did she have a female role model. In school, at the age of 15, she actually experienced a physics teacher who, despite her good marks, repeatedly tried to persuade her to choose biology rather than physics, because biology is ‘a more feminine subject’. She does, however, mention one particularly good science lecturer who influenced her in a positive way. Nevertheless, all three strongly agreed that more role models are needed in academic physics education, to create an environment that attracts and encourages female students.

There is considerable research (Clegg 2000; Crawford and MacLeod 1990; Ferdos 2004; Millis and Cottell 1998 and Wisker 1997) that shows that certain styles of teaching and learning are appreciated by women. For example, teaching that is centred around student activities and active learning rather than one-way lecturing about established knowledge. One may argue that is simply good pedagogy from which students of both genders will profit. In this context it is worth mentioning that a new undergraduate programme, ‘Problem solving in natural sciences’ was
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introduced at GU in 1995. This programme consists of studies of physics, mathematics and environmental science (leading to a Bachelor’s degree) and is more problem-based than the traditional physics education at CTH. Significantly the percentage of female students for this programme has been as high as 50%, considerably more than in the traditional courses (HSV, 2001).

Working environment

The interviewees were asked to comment on their working environment at CTH, where most research took place. They were also asked if they thought an increased number of women might improve it. The answers that were given, differed strongly from each other – perhaps not so surprisingly, as the three women are at different stages of their careers. The PhD student had no negative experiences at the undergradutae level where the ratio, on average is is 80% to 20% in favour of male students. She claimed that most of her fellow female physics students would agree. In her opinion, this distribution is ideal. She felt it created an honest, open and relaxed atmosphere and an increased percentage of women would probably destroy it. She never noticed any kind of unpleasant sexist behaviour and felt that the attention she had received as a woman among a majority of men, was only positive. The lecturer on the other hand, experiences the CTH culture as too traditional, hierarchical and somewhat hostile. In her opinion, women tend to feel that they have communication problems with their male bosses. She thinks that, in general, an increased number of women does improve the social atmosphere at the working place, but she has also experienced that too many women (over 50%) in the group can create problems.
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Our third informant who is a full professor and group leader, has much of the responsibility for creating the working environment in her group. According to her experience, an increased number of women makes the atmosphere nicer, less aggressive and less competitive and this is appreciated by both the men and the women in her group. This is in accord with the second working assumption of the Physics Faculty’s plan of action The only sexual harassment she has experienced at CTH, is that some of her group members from Eastern European countries find it difficult to accept a female boss.

**Quantitative work for equality: special positions**

Some years ago Sweden introduced special professorial positions for women – the so-called ‘Tham professorships’. The idea was to increase the number of female professors being appointed. It was a controversial decision and led to much discussion in the academic world and the media. A common objection is that by excluding male applicants, one may exclude candidates who are far more competent than the person who is appointed. Moreover, even if the appointed female candidate *is* highly competent, selective recruitment may not be good for her scientific reputation or her self-confidence. A counter-argument is that is quite common to fill academic positions without true competition. Positions are often opened for a particular (local) candidate who happens to have the right contacts, and there are ways to make sure that this person will be on top of the list, for example, by announcing the position within a very narrow field. In this context, it is argued, powerful senior professors – who are usually men – tend to promote other men. The special positions for women may be a way of breaking this vicious circle and increasing the number of female leaders and role models in the sciences.
We discussed the above point in the interviews. Interestingly, although all three emphasized that more female role models are needed in physics they were all sceptical about creating special positions. The PhD student believed that pushing women into the system is an efficient tool to create a role model avalanche – women attract more women. However, the women in the pioneering generation, that is, those holding the special Tham positions, may suffer as their competence can be doubted. The lecturer supported this last point and said that she holds a special women’s position and has been experiencing strong self-doubts because of this. She reiterated the point above, that she feels her gender, rather than her competence, is the reason why she has been offered positions without having to compete openly. She is, nevertheless, generally in favour of such positions, as long as there is a true requirement of competence. Moreover, she believes that, even though in a given case some male candidate might have had better scientific merits than the woman appointed, there are often other qualities, good teaching skills for example, that tilt the scales in favour of the woman. The professor, however, was totally against positions where only female applicants are allowed. She believes that it is more important to get rid of old-fashioned, discriminating attitudes against women in physics, especially among those who have power in the academic hierarchy.

The professor raised another important point. As we noted above, there is a push to have at least one woman on every PhD committee (and other committees). Due to the small number of women in the system, the professor is frequently asked to be on such committees, and she is totally against this rule. It puts an increased administrative load on the few available women, which keeps them from doing their research. The professor believes that it is important for female physicists to be visible, but, she argues, there are better ways of being visible than as the “token
woman” on a PhD committee. Judging from our sample of interviews, the measures taken by politicians and leaders to obtain equal opportunity for women in physics, are not necessarily appreciated by the female physicists themselves.

Concluding remarks

This study mainly concentrated on the situation of female physicists at and above PhD level. However, there are mechanisms that tend to scare girls away from physics and mathematics at a much earlier stage (childhood and school). The work for gender balance should start there. In this paper we have argued for a combination of quantitative and qualitative measures to improve the participation and contribution of women in a particular Physics faculty in Sweden. Our interviews with a cross section of female physicists confirmed many ideas and arguments in the literature. An essential element in improving the situation of women in physics, in Sweden and elsewhere, is a rational dialogue based on well researched facts. We believe that more studies of the kind we have presented here will contribute in a significant way to such a dialogue.

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