How to recruit Women Students for Technical Universities
Case Study

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ABSTRACT

Here, the first results of a broad case study are depicted. In this survey students of the 9 renowned German technical universities were interviewed. The main topics were demographic data, their motives for choosing their university and subject and how they informed themselves during the decision period before studies. Further we found out that the study program is indeed a high challenge when about half of the students do not feel well prepared by their school and most estimate their performance as “intermediate”, least as “very good”. Interestingly enough, women feel socially quite accepted but about half of them approve there is an outward pressure on women to proof their skills to be acknowledged equally.

Keywords: gender, engineering education, university

1. INTRODUCTION

As in most societal fields differences between men and women are becoming less important and less visible the whole technology sector is catching up with this development of modernization and individualization. Here we will focus on the position of women in the German engineering education system, namely at technical universities and introduce first results from a project. German technical universities, as well as most technical universities worldwide, are places mainly populated by men. The higher the hierarchical position, the lower is the percentage of women workers, assistants, professors, directors. These structural gender relationships can be found through all professional fields and therefore also in technical academia, even though in less dimensions. Engineering cultures themselves develop more and more a sensitivity for this fact but apply the supposed principles neutrality and objectivity in their personnel recruitment [1].

But since Germany as a country whose economic success is mainly based on the export of technology faces lack of qualified engineers, the governmental concern to monitor the engineering education is becoming louder and louder [2]. Not only is the percentage of women students starting in engineering study programs outstandingly low, with about a third the dropout rate of men and women in engineering programs is also higher than in other study programs. In this context, three argumentative lines about women engineering students are being brought into the field: economy, quality and equity:

• Economic argument: Since Germany needs more qualified engineers and since the men resources seem to be exploited, one goes back to the almost untouched resources of talented women students.

• Quality argument: A better gender balance will improve teamwork and product development in the technical field, and thus make enterprises more innovative and able to compete globally.

• Equity argument: Women ought to have the same opportunities to decide for professions on behalf of their abilities and their interests – also to benefit from the very good professional chances in the technical field.

2. THE PROJECT AND FIRST FINDINGS

The project “Spurensuche!” (“Seeking Traces”), funded by the German Federal Ministry of Education and Research, aims to find out the processes how students choose their engineering subject as well as their first experiences once they have started to study that subject. It displays where significant differences between women students and men students might be. By that, it hints at attracting more women students. The project scrutinizes the four engineering subjects physics, computer sciences, mechanical engineering as well as electrical engineering at the German association of nine large technical universities, the TU9. The TU9 is a federation of the nine most renowned and successful technical universities in Germany. The survey is being conducted during teaching sessions. In that way, as many students as possible can be reached. The student survey was finished by the beginning of 2009, and results of the full survey shall be calculated by spring 2009.

2.1 Who comes to TU9?

Here we present some first, intermediate results of the student survey (currently N= 1050 valid cases). Whereas the percentage of women students at German universities comprehending all subjects is 58% [3, pg.
1) [4, pg. 4], they are still a minority in technical subjects and are subjectively perceived as exceptions (20%). The “normal student” is a man and German. In our inquiry 78% of all students are German men. The percentage of women students varies among the subjects as well as among universities: from 11% (computer sciences in Darmstadt) up to 23% (physics in Berlin). Women engineering students come slightly more often from an academic background than men (59% of the women students have fathers with a university diploma or PhD, whereas only 54% of the men students). In 35% of the cases both mother and father have a diploma or PhD. This shows that engineering subjects can no longer be considered as a social upward climb but as “academic reproduction”2. The McKinsey study on education states that the students’ educational successes do depend nowhere as strongly on their social background as in Germany [5, pg. 53] – which is even truer for women.3

Concerning national and cultural background, a cultural gap comes into play: the percentage of Non-German students in our sample is slightly higher among women students than among men (12.5% women vs. 8% men). Different studies have shown that the concept of technology as an exclusively male field varies from country to country [6], [7, pg. 26-38]. There seems to be a connection between the general economic wealth of the country and the importance that engineering subjects do have. The hypothesis can be, the lower the prosperity of a country and the reputation of engineers, the more open will the country be for women engineers. The figures show that in some other European and Non-European countries women seem to be ascribed a less unusual role when they study a technical subject.

2.2 Motives for Subject and University

The queried men and women of our study are very much comparable in their motives for choosing the subject (see Figure 1). The most important motive for both is an intrinsic one, “Interest in the facts” (87% women, 91% men)4 followed by only extrinsic motives, such as “good salary” (58% w, 66% m), “good grades” (62% w, 57% m) and “high prestige” (42% w, 47% m)5. In accordance to preceding surveys [8], good grades are an important factor for women in men’s domains [9].

1 This figure includes all engineering subjects, also e.g. architecture; Comp. http://www.vdi-monitoring.de
2 the highest „academic reproduction“ is in medicine (66%), the lowest in social work at universities of applied sciences.
3 Our inquiry figure is even a little higher than the German percentage of “academic reproduction” in engineering subjects with 49%
4 The findings from the student survey [4] show the same results for men but less interest for women (69%).
5 1&2 added out of a range from 1 “very important” to 6 “not important at all”

![Motives for choice of subject](image)

**Figure 1**

Here, their deviating role comes into play again, possibly as insecurity in this field, or overestimation of the requirements, when women in engineering feel the need to ensure themselves by their provable accomplishments, visible as good grades. These findings are strengthened when we take a look at their grades: the selection of women starting engineering subjects have graduated from school more successfully than the selection of men (1.9 vs. 2.1 median grade for Abitur (A-Level)) – that means the women with lower grades hesitate to study engineering subjects in a contrary to men.

Most men and women in the TU9 sample chose their specific university for its “good reputation”, whereas this external factor is even more important for men than for women (65% w vs. 73% m). Half of all students chose their university because it was close to their homes, and because of “the city” (45% w & m). Here, the way of decision is easy to track: They like maths & sciences and are good at it, want to earn money and have a good standing, so some of them go to the most renowned university, and others to the next university nearby.

2.3 Information, Women and Contentment

Before entering a university, students can take part in different offers to inform themselves. The attendance in an informative event such as “students-info-day” (Schüler-Info-Tag) or “high school graduates’ day” (Abituriententag) supports both men and women in their choice of subject. But it becomes obvious that women in engineering studies need this informative support even more than men to decide for an untypical subject. 60% of the men but 69% of the women took part in such an event before studying. When questioned
about the effect these offers had, they were important especially for girls to support the idea to study that subject (48% w, 40% m) but also took their insecurity away if they can succeed in the subject (21% w, 9% m). For a fifth of the girls the informative offer succeeded to transmit a picture of the profession (19% w, 9% m). This shows how much effect these offers have and that there might be a good potential to reach more girls and boys during their school years to attract them for a study program [10]. Ihsen et al. have reported about the effects of Girl’s Day [1].

In general, German engineering education has the reputation to be of high quality but therefore quite difficult. We asked the students how well school has prepared them for their study. Figure 2 depicts that the responses are very heterogeneous. Very few feel prepared “very well”, less than 20% feel prepared well. Women feel slightly worse prepared than men (answer categories 1=“very high” to 6=“very low”; mean: 3.77 w / 3.61 m). Here a great potential opens up to improve the chances for a successful entry to university.

Further, we asked the students how they perceive the level of their subject. Over 80% of the young women and men ticked that they find it “very high” or “high”. Women find it even more often “very high” (52%) than men (42%) (mean: 1.61 w / 1.69 m). Nobody finds it “low” (comp. Figure 3).

Only few students think they do “very good”, most feel they are in a good middle (comp. Figure 4). Quite similarly to that, only few students feel “absolutely sure” to fulfil all requirements (comp. Figure 5).
With the high dropout rate of over 30% in the first semesters of many engineering subjects [11], the difficulty seems to be the transition phase from school to university. We wanted to know if mainly the conditions of the university study are hard on the teenagers or rather factors outside the university. Actually, most students ticked that the “amount of study material” is a very high challenge for them. Whereas the highly theoretical learning is not as difficult as expected, [12] After the amount of material the students feel problems in their social situation. First time leaving home and living on their own is a hard change for them. So, “finding new friends”, the “new city” and being “away from parents’ home” are serious problems for many of them. Here support is needed most but not really in the hands of the university.

Surprisingly, for most the dwelling situation and independent studying is easy to cope with. When women students have a harder time coping with “mass university” than men, it may hint to a worse integration among the students (comp. Figure 6).

Focusing on the women in these subjects, we asked the women students how they feel. Over half of them feel comfortable among the male crowd (55%) [12]. Only 6% don’t feel comfortable at all [11]. A few women (15%) do feel they have an outstanding role (“Sonderrolle”), but only 3% feel excluded by men. So far, these figures seem to show an overall social acceptance. But does social acceptance mean acknowledgement as women engineers and professional integration? Here, a complete different picture displays. In spite of their seemingly social integration, their deviant role displays in their professional relations: 52% of the women students (23% of the men) believe that women in engineering subjects have to prove their skills more strongly than men to be approved. That is the reason why women hesitate to choose engineering subjects. This again shows that the technical skills of women are doubted, in a turn creating a higher pressure on the individual. It implies the perception of an inconsistency between being an engineer and a woman. Women engineering students are perceived to “be in the wrong place”, and to have a deviant role is answered by 25% of the women (9% of the men) who think that women have to permanently justify themselves for their choice. When asking women students about their personal feelings, 18% agree that they have to prove their skills more than the men (comp. Figure 7).

<table>
<thead>
<tr>
<th>How well can you cope with the following situation in your study and life situation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = &quot;can cope very well&quot; to 6 = &quot;can hardly cope&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of study material</td>
<td>4.00</td>
</tr>
<tr>
<td>Find new friends</td>
<td>3.90</td>
</tr>
<tr>
<td>New city</td>
<td>3.90</td>
</tr>
<tr>
<td>Away from parents’ house</td>
<td>3.67</td>
</tr>
<tr>
<td>Mass university</td>
<td>3.50</td>
</tr>
<tr>
<td>Study theoretic</td>
<td>3.50</td>
</tr>
<tr>
<td>Financial situation</td>
<td>3.40</td>
</tr>
<tr>
<td>Freetime management</td>
<td>3.30</td>
</tr>
<tr>
<td>Independent Studying</td>
<td>3.20</td>
</tr>
<tr>
<td>My dwelling situation</td>
<td>3.10</td>
</tr>
</tbody>
</table>

Figure 6

Women are still a minority in your subject. How much do you agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>women have to prove</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>career and family hard to combine</td>
<td>27</td>
<td>25</td>
</tr>
<tr>
<td>bad career chances for women</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>have to justify for technical choice</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>women are fine with outstanding role</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td>minority role makes it easier</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>interested in other topics</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>don’t want to study subject when minority</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>contradiction: engineer woman</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Figure 7

Here again, these students feel that their surrounding suggests that they dissent from their role when choosing an engineering subject. This dissent is grounded on their construction of gender roles as well as the construction of “the engineer” [13]. These findings have been regularly confirmed by preceding studies over years [14], [15], [16]. These disagreeing findings

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6 answer 1&2 added out of 1-6
7 answer 6
8 answer 1&2 added out of 1-6
(social acceptance versus missing acknowledgement as engineer) reflects the cognitive dissonance: the women students are only able to feel comfortable in this field by not reflecting about their situation and thus avoid the inner conflict. Being asked directly though, only very few agree to the statement that it is a contradiction between being a good engineer and being a woman (4% w / 6% m).

Strikingly, only 17% w / 13% m are “very content” with their subject9, whereas 47% w / 43% m are “content”10. 12% w / 19% m are “not content”11 with their study. It is not surprising, that there is a highly significant correlation between the contentment with the study and the question if it meets their expectation. For both, four fifth are on the positive side.

64% w / 58% m tick they have informed “well” about their studies before starting. Here again, the coherence between information and meeting the expectations is highly significant, even much higher for girls (Pearson R=0.38 w / 0.26 m). This means that students who inform well are more likely to be content with their decision (possibly because they have made the right choice). They enter university with realistic expectations and become satisfied students who might more liable to succeed. This correlation is even stronger for women students than for men students. Here a reliable resource to recruit more women engineering students can be tracked: if good girl school students are informed well about the study programs and future professions and encouraged that they can succeed, they are very liable to become successful women engineers.

3. CONCLUSIONS

Finally, it can be concluded that over half of the engineering students come from academic families. In most respects women and men engineering students are very similar in their motives to choose the subjects and universities. But when asked about the specific role of women the data shows that women still have to struggle strongly for their acknowledgement as women engineers. That is why women more often ensure themselves by their good school grades. To attract more women (and also men) students, informative events have proved to be very successful by taking insecurity away and informing about possible professions. Well informed beginners are more likely to become content students. Here, clearly, a strategy to recruit more women students could be further extended by campaigning engineering programs more strongly in the schools. These first findings are now only a first step and we shall see how the results will come out when the full data can be evaluated.

4. REFERENCES

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