

What Drives Young Women to Study Computer Science in Switzerland? – Experiences on Promoting Computer Science Studies for Female High School Graduates

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ABSTRACT

In Switzerland, more than in other European countries, girls have rarely chosen to study computer- or technology-related subjects. Currently, women comprise only 10% of the computer science students at the Swiss Federal Institute of Technology Zurich (ETH), the largest technical university in Switzerland. In this work, we analyse the enrolment of female students at the ETH during the past 18 years. Our analyses indicate that womens' career decisions are driven by market development and future perspectives to a larger extent than those of men. Motivated by the wish to create a heterogeneous and thus diverse, inspiring, and productive study and working environment, we present our approach to increasing the number of female computer science students. Furthermore, we evaluate the motivations and interests of prospective female computer science students. On a longer term, understanding what fascinates young women about technology may open the door for universities and society to adapt in order to meet the visions of a new target group for computer scientists.

Keywords

Computer Science, Promotional Program for Women, Technical University, Gender Distribution

INTRODUCTION

The image of computer science (CS) in Switzerland has recently been subject to a comprehensive study [1]. Results show that only 3% of the Swiss high school students plan to pursue computer science studies. The large majority of the general public, but also of high school students and teachers alike, assume that computer science deals with the use of personal computers, mobile phones, Internet, and applications. Skills in computer science are widely considered to be equiv-

alent to usage abilities. The study further reveals that *not even 1% of the female high-school students who want to pursue university studies choose computer science as their primary university subject*, whereas this number reaches 5% for male high-school students. Not surprisingly, these low numbers and their bias in gender are reflected at the university level: over the past 18 years, not even 10% of the computer science students were female [2].

In the remainder of this work we will cover the following: In the first part, we will analyse the development of female enrolments to computer science at ETH and the students' success during the studies. In the second part, we present our approach for increasing the number of female computer science students, the core of our activities being the *Schnupperstudium* – an intensive one-week course for promoting computer science to female high school graduates.

CURRENT SITUATION AT ETH

We first analyse the gender distribution for bachelor, master, and diploma computer science students at ETH Zurich, as displayed in Figure 1. Between the years 1990 and 2007, the average total number of CS students was 807 out of which 65 (8.1%) were women. Both the highest percentage (11.4%) and the highest absolute number of female CS students (122 women among 1067 students) was reached in 2001 in align-

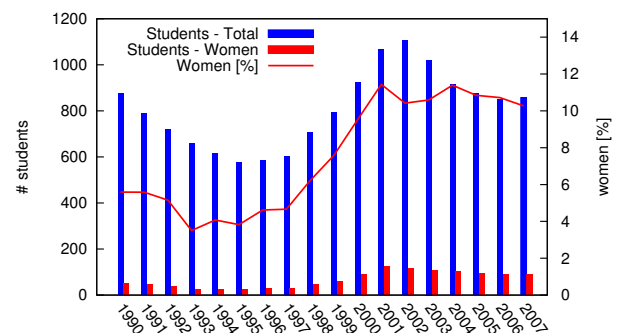


Figure 1: Gender distribution of bachelor, master, and diploma CS students at ETH Zurich. Total: $\bar{X} = 807$, $\sigma = 165.2$; Women: $\bar{X} = 65$, $\sigma = 35.8$

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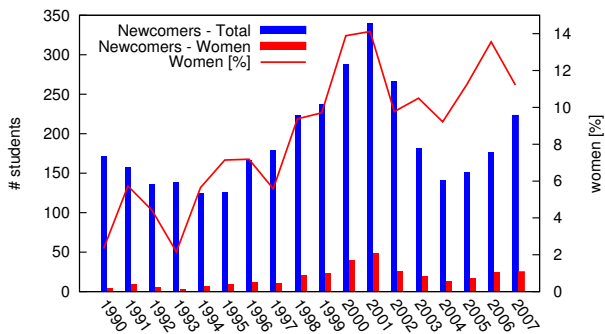


Figure 2: Gender distribution of CS newcomers to ETH Zurich pursuing bachelor, master, or diploma studies. Total: $\bar{X} = 181, \sigma = 60.7$; Women: $\bar{X} = 17, \sigma = 11.8$

ment with excellent market and career perspectives until the turn of the century (Internet and dot.com hype). Since 2001, the percentages of female students have remained just above 10%, numbers unreachable in the years before. These numbers and tendencies become even more distinct when we consider the gender distribution of newcomers to the Bachelor, Master, and Diploma CS programs, displayed in Figure 2. The peak of female newcomers was also reached in 2001 with 14.1% female students (48 women among 340 newcomers) and the minimum occurred in 1993 (3 women out of 139 students). After 2001, the percentages of female newcomers again dropped while another local peak was reached in 2006.

What do these numbers indicate?

Around the turn of the millennium, the visibility of computer science reached a peak due to the increasing spread and dominance of new web-based applications and excellent career perspectives. Not only the absolute number of women starting computer science studies increased significantly around that time but also their percentage among all CS students. In other words, women reacted to this development stronger than men. This may lead to the conclusion that men decide on pursuing computer science studies earlier in their lives, possibly due to a fascination for technology and computers, whereas women may be influenced in this decision stronger by public perception and professional perspectives. We will give further indication of this reasoning later in this work, but already remark here the importance of targeted advertising strategies by universities and the market. We note that this is not a representative study but only showing the developments at a single – though the most important – technical university in Switzerland. As a reference, during the same time, the percentage of women in all subjects at ETH increased only slightly from 26.3% in 1995 to 29.4% in 2001, while the same percentage for computer science almost doubled during that time (from 7.1% in 1995 to 14.1% in 2001).

Given the percentages of female enrolments and their development, we are further interested in the question whether female CS students are as successful as their male colleagues during their studies. One way of answering this question

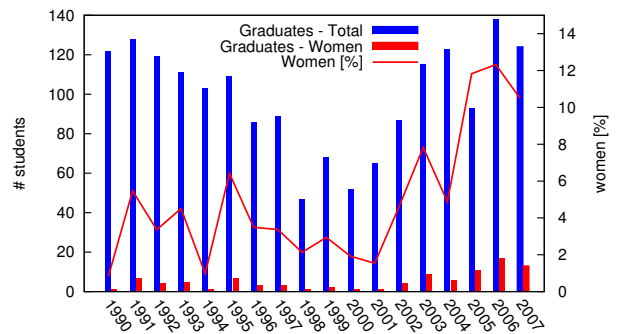


Figure 3: Gender distribution of the diploma and master graduations of CS students at ETH Zurich. Total: $\bar{X} = 98.8, \sigma = 27.1$; Women: $\bar{X} = 5.3, \sigma = 4.6$.

considers the graduations. Figure 3 displays the distribution of master and diploma graduations¹ which were awarded between 1990 and 2007. Out of 1779 graduations in total, 96 were awarded to female CS students (5.4%), which, in average, makes about 5 graduations of female students per year. The percentages vary significantly between 12.3% in 2006 and 0.8% in 1990. These numbers seem to indicate that women are less successful than men during their studies (5.4% graduations of female students as opposed to 9.5% female newcomers and 8.1% female students in total). While the number of graduations is indeed a strong indicator for success, we note that in this analysis we disregard other indications of study success such as length of studies or grades achieved. Most importantly, we point out that due to the low absolute numbers, each woman not finishing her studies is reflected stronger in the percentages than male dropouts. An important aspect is that female CS students aborting their studies may furthermore have an indirect effect on the number of women graduating. Due to a lack of possible individual replacements it is very discouraging for female students if one of them aborts her studies, in particular if they have been supporting each other or at least represented mutual attachment figures. This is also confirmed by our data: *roughly five years* (the typical study duration) *after an increase in the female percentage of newcomers we observe an even higher, disproportional increase in the percentage of graduations.*

Why is an underrepresentation of women in CS a problem?

Viewed from top-down, it is disputable if our information society can discard half the potential of the population. There is (still) a skill shortage in the area of computer science in Switzerland, at the same time specialised and well-trained workforces are desperately looked for by the industry. Increasing the absolute numbers of female computer science students represents one solution to this problem because more

¹Until 2003, the only awarded graduation was the diploma. The diploma system was then transformed into the bachelor/master system. During the transition phase, both diplomas and masters were awarded between 2003 and 2007.

computer scientists will graduate and, consequently, they will meet the educational goals set by the national universities.

A second argument concerns the quality and characteristics of developed products. If information technologies and IT applications are mostly developed by men in their twenties and thirties, the software mainly complies to their wishes and visions [3, 4]. However, the resulting products are to be used in general by all members of our society, in particular also by women. Consequently, women must be part of the design, requirement specification, and development cycles.

Third, the added value of a heterogeneous working environment comes in terms of higher group cohesion, job satisfaction and organisational attachment, as analysed in numerous studies and stated, e.g., in [5] and the references therein.²

Finally, viewed from bottom-up, the underrepresentation of women raises the barrier for new women joining this field due to a lack of colleagues and role models to identify with.

In short, *women should not be excluded from computer science*. In terms of an equalised society, women must not be deprived of excellent career perspectives and professional recognition that the work as computer scientist can offer.

INCREASING THE NUMBER OF WOMEN IN CS

In order to counteract the underrepresentation of women in computer science at ETH, the Forum of Women in Computer Science (dt. *Frauenförderung*) was founded. The primary goal of this forum is to increase the number of female CS-students. Today, the Forum of Women is well-established in the department, being headed by two doctoral students whose work is recognised equivalent to mandatory teaching responsibilities. The current team consists of two doctoral and four undergraduate students.

The first activity took place in 1993 with the publication of a brochure advertising computer science as a promising future for girls. This brochure (see Figure 4) has been maintained until today and represents an important factor of the publicity work, drawing an encouraging but realistic image about computer science studies and computer science as a profession.

Nowadays, the Forum organises numerous events and programs, both for female high school graduates and for female students at the department. The events target at making computer science studies more attractive to women and at enhancing the working environment with aspects that tend to be overseen in male-dominated surroundings.

On the one hand, for women at the department, this is being achieved by means of social events and networking opportunities (e.g., aperitifs and 'women-compliant' video sessions), by broadening the knowledge about career perspec-

²Regarding intergroup cohesion [5]: "The percentage of women in university departments was positively related to workers' perceptions of cohesion, with men in all-male departments expressing the least cohesion". Regarding job satisfaction [5]: "Men in predominantly male and mixed-sex work groups were more satisfied than men in all-male groups, both sexes in gender-balanced work groups were more satisfied than workers in homogeneous groups, with workers in male-dominated groups reporting the least satisfaction".

tives (female computer scientists reporting about their experiences in industry and/or academia), and by events improving women's technical and personal competences (e.g., Linux crash course, hardware crash course, presentation techniques workshop). These events are offered for women only whenever we consider it reasonable for the personal development and the success of the event (presentation techniques workshop, round table for sharing industry experiences). Otherwise men are permitted to attend, also in order to increase the awareness of our work and goals. Occasionally, we offer the same workshop twice (e.g., hardware/Linux crash course), once for women only and once for both genders, in order for a broader audience to profit from the events and to leave women the choice of which environment they prefer.

On the other hand, the Forum of Women tries to support female Swiss high school graduates in the decision making process of their future profession. It offers support for female high-school students who conduct their graduation theses in the area of computer science (dt. *Maturaarbeit*) and, most important, by a one-week introductory course to CS (dt. *Schnupperstudium*) that introduces young women to programming, the academic environment, facets of computer science, and gives typical first-hand job experiences. The course is offered twice a year, exclusively to women.



Figure 4: Cover of the brochure “(Female) Computer Scientist – an exciting future“ [6], published by the Forum of Women in CS at ETH Zurich and available on the website [7] (German only).

Schnupperstudium Informatik

During the past ten years, the *Schnupperstudium* has been offered 19 times. Between 2001 and 2006, a total of 225 young women participated in 10 courses, with an average of 23 participants per course. As a rough estimate, half of the women starting CS bachelor studies had participated in one of the *Schnupperstudiums* before, and 22% (49 women) of the *Schnupperstudium*-participants between 2001 and 2006 have so far enrolled in computer science studies (this number is likely to still increase in the next years when all inter-

ested participants have taken up studies). Furthermore, 7% of the participants of the Schnupperstudiums between 2001 and 2006 have so far started studies in Electrical Engineering, Civil Engineering, or Mechanical Engineering; another 4% have started in Mathematics or Physics; additional 7% in any other study at ETH (e.g., Chemistry, Biology, Environmental Sciences, Architecture). In many of those fields of study, women are also (strongly) underrepresented at ETH.

The *Schnupperstudium* is offered as an intensive one-week course. The morning sessions are dedicated to an introduction into programming (currently by means of Java and by using the learning programs Kara and JavaKara [8]). Presentations introducing programming concepts alternate with practical sessions on the computer during which the participants try to apply what they have heard. We do not require any prior programming knowledge; at the end of the week the participants are usually able to implement fundamental algorithms (such as a binary search algorithm). During the practical sessions, two to three CS student assistants support the participants (in the beginning mainly for compiling errors, later for structural questions). As a fundamental principle, the assistants will neither touch the keyboards nor mice so that the participants always remain in control. This is essential for the participants to experience themselves as origins of the final running program. The tasks are selected such in size and complexity that they provide numerous feelings of success.

The afternoon sessions are split into a diverse program: PhD students present their areas of research, two women working as computer scientists report about their experiences and give insight into their work, the participants get an overview over the study contents as well as the chance to discuss and get questions answered by female CS students during a round table session. The program is rounded off by a visit of a famous local computer science research center (which is usually reported as one of the week's highlights by the participants) as well as a dinner in a nearby restaurant. The week is free of charge for the participants.

74% of the 128 participants between 2004 and 2008 expressed that the course had a positive or strongly positive effect on their motivation to study computer science (4% claimed the course to have had a negative impact on this decision). Furthermore, over 95% of the participants said that, after the course, they understood better or much better what computer science is and 40.5% expressed their plans to take up computer science studies (25% did not plan to take up CS studies and 34.3% were undecided).

Girls' Motivation and Interest

Apart from these numbers, we are especially interested in understanding the motivation for young women to get engaged

in computer science. The application form for our course thus requires an essay to be written by the applicants, describing their interest in computer science. The reasons quoted most frequently are *relevance of computers for everyday life* and *curiosity of how programs are written* (each named 62 times in 171 applications), closely followed by *fun during work at the computer* (57). Less often, the applicants named *fascination for computers* in general (39), *enjoying logical and analytical thinking* (38), *fascination for programming* (33), and the *promising future of computer science* (27). According to our study, the decision factors of young women who are developing an interest in computer science and consider this subject for studies are rather forward-oriented (relevance, curiosity, and fun) than backward-oriented (long experience, already developed fascination for computers and programming). Therefore we believe that attracting women to computer science by presenting interesting technical content, role models, and professional outlooks can make a difference in balancing the gender distribution in computer science. The percentages of female newcomers (at or above 10% as of 1999 when the *Schnupperstudium* started, considerably less in the years before, Figure 2) seem to confirm the positive impact of the *Schnupperstudium*.

REFERENCES

- [1] Umbach-Daniel, Anja, and Wegmann, Armida. *Das Image der Informatik in der Schweiz*, Rütter + Partner, April 2008
- [2] ETH Zurich. *Numbers and Facts about ETH*, 2008, <http://www.fc.ethz.ch/facts/studierende>
- [3] Zimmermann, Judith. Warum braucht die Informatik mehr Frauen? *Professional Computing*, 2005
- [4] Kleinn, Karin, and Schinzel, Britta. Wie Software-Entwicklerinnen und -Entwickler ihre Arbeit beschreiben. *FifF-Kommunikation 3/2001*, Forum InformatikerInnen für Frieden und gesellschaftliche Verantwortung (FifF), 2001
- [5] Reskin, Barbara F., McBrier, Debra B., and Kmec, Julie A. The determinants and consequences of workplace sex and race composition. *Annual Review of Sociology*, Vol. 25, Pages 335-361, August 1999
- [6] *Informatikerin – Eine vielseitige Zukunft*. Brochure of the Forum of Women (Frauenförderung) at ETH Zurich. 9th edition 2008. <http://www.frauen.inf.ethz.ch/docs/InfZukunft.pdf>
- [7] Website of the Forum of Women at ETH, <http://www.frauen.inf.ethz.ch>
- [8] Swissheduc, Unterrichtsmaterialien im Umfeld der Sekundarstufe. <http://www.swissheduc.ch/informatik/karatojava>