



2nd International Conference on Higher Education Advances, HEAd'16, 21-23 June 2016,
València, Spain

The Women's Bachelor Programme "Computer Science and Business Administration" and its Consistent Orientation to Practical Training

Juliane Siegeris*, Jörn Freiheit, Dagmar Krefling

School of IT, Media and Business, HTW Berlin - University of Applied Sciences, Germany

Abstract

This paper describes the teaching and learning experiences made at the women's Bachelor degree programme 'Computer science and business administration'. It focuses on the consistent orientation towards practical experiences. Different courses are described showing the strong emphasis on practical training. One special course is described in more detail: 'Industrial project', which is held in both semesters, third and fifth, and where teams of students perform real projects for private clients from industry.

It is shown that the entire programme is geared to offer practical experiences as much as possible to the students. After two semesters of teaching foundations of computer science, the students carry out the first industrial project supported jointly with advanced students from the fifth semester. At the fourth semester the students complete their 4-5 months internship, the fifth semester students attend the industrial project again and in the sixth semester the students write their Bachelor thesis, usually at an industrial partner's site. The women-only Bachelor degree programme has started in 2009 and has been developed to a success story since then. Almost all graduates have found a job immediately after the studies, or have continued a subsequent Master programme.

© 2016 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the organizing committee of HEAd'16

Keywords: industrial projects; practical experience; women-only; computer science; educational strategies.

* Corresponding author. Tel.: +49 30 5019 3317; fax: +49 30 5019 48 3317
E-mail address: Juliane.Siegeris@HTW-Berlin.de

1. Introduction

In 2009 the University of Applied Sciences Berlin (HTW Berlin) has implemented the women-only Bachelor degree programme *Computer Science and Business Administration* (Informatik und Wirtschaft). In this paper we present the programme that is not only mono-educative, but also differs with respect to curriculum and the framing conditions from comparable standard degree programmes. Some of its speciality result from its consequent orientation towards practical experience. In the following, we describe the different teaching formats and their interplay.

2. The Degree Programme 'Computer Science and Business Administration'

The University of Applied Sciences Berlin has a long history in engineering education. The studies of applied sciences at the HTW Berlin lead towards professional practice. Thus, teaching has a strong emphasis on practical application. In the field of information technologies, the institution offers a range of 12 different bachelor and master degree programmes. Among them, the Bachelor's degree course 'Computer Science and Business Administration' has been funded in 2009. It is a mono-educational degree programme, which aims to encourage women to study computer sciences. The decision to set up this programme was inspired by the successful women's colleges in America. Furthermore, the support of a partner programme in Bremen was obtained (Hochschule Bremen City Univ. of Appl. Sc., 2016).

2.1. Target Group

The program was set up to gain more female students for the IT-Sector. As a matter of fact this is achieved, as a high percentage of our students would not have studied computer science at all. This is a result of a questionnaire handed out at the beginning of the programme. Some students say that they did not dare to study computer science as they thought they would not have met the same requirements as their male classmates (who, they suppose, spent most of their time working or playing with a computer). A further indicator is the wide diversity of the student group. The course also attracts elder students (age 30-45), who have a pragmatic interest in tapping into good job opportunities. They aim to achieve a further qualification, but do not want to sustain their position among young male 'nerds'. Other statistics show that the proportion of mothers and women with a migration background are significantly higher compared to statistics including all students in Germany (in the latest semester 17 % of the students are mothers (compared to 5-6% of all students) and 34 % have a migration background (compared to 23% of all students). It also appears that the programme is chosen quite often by students that either already have other qualifications or do not have a German 'Abitur' or equivalent qualification for university entrance, but vocational training and at least three years of work experience. The diverse mixture of women within our programme confirms that the strategy is successful. The more comprehensive evaluation of these phenomena and the deduction of possible consequences for a better designation of the target group is the topic of a current PhD thesis.

2.2. Functional Scope and Practical Emphasis

It has been shown, that women are attracted to so-called hyphenated programmes (e.g. life-science), which combine interdisciplinary fields (Margolis & Fisher, 2003). This can be attributed to the assumption that women's interests are wider spread and more holistic. The programme takes this assumption into account by combining computer science with economics. The students not only learn IT-techniques and -methods but also the technical terms and typical tasks of an important application area. However, in contrast to typical Business informatics studies, the focus is much more on computer sciences. Courses related to informatics form the majority of the curriculum, cf. Fig. 1.

It has also been shown, that women are especially attracted by programmes which are applied and build bridges towards practical work (Corsun & Costen, 2001). Therefore, the study courses set a high value on the transfer of learning content to practical application. In order to empower the students for their later work life, different

educational formats focusing on practice transfer have been set up. The following components are integrated into the curriculum:

- at least six visits to IT companies in the region,
- a full-time work experience of at least 17 weeks,
- two IT projects with external industrial partners as clients.
- guest lectures in normal courses (demonstrating the students the applicability of the conveyed material).

Furthermore, the students are encouraged to write their bachelor thesis in conjunction with an external partner.

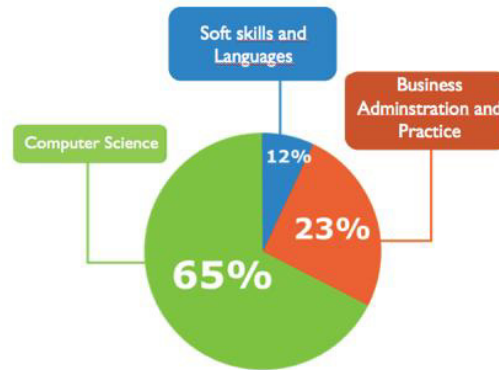


Fig. 1. Distribution of lectures in the curriculum

2.3. The Curriculum

The curriculum of the programme is designed to support the student's practical experiences as soon as possible. However, as the study course particularly addresses women who are not attracted by the standard study courses in computer science, 'starting from zero' is explicitly promised and has been found to be appreciated by many students as a reason to 'dare' studying computer sciences. Fig. 2 shows the order of the practical units within the curriculum. In the first semester, the students are introduced to the subject, by learning the IT-basics (e.g. programming skills, computer architecture and operating systems, theoretical informatics). The lecturers are in close mutual contact to establish as many links as possible between the different courses. Thus, exercises often build on material of the other courses and help to reflect the interconnections between the different subjects.

The second semester strongly focuses on the empowerment of the students to practical application of their skills. Methods of self-study and solution finding strategies are key competences to be conveyed. IT-courses in the second semester are software engineering, advanced programming and computer networks. The empowerment is supported by various didactical methods. We employ e.g. pair programming, social media (students exchange their knowledge in electronic discussion forums and jointly create glossaries and wikis), team-work (with changing partners) and development of cooperative solutions. The exercises differ in their didactical aim. One part of the exercises requires systematic research, other parts can be solved by applying trial-and-error methods. Here, inter-course exercises focus on reflection of the different phases of a product life cycle.

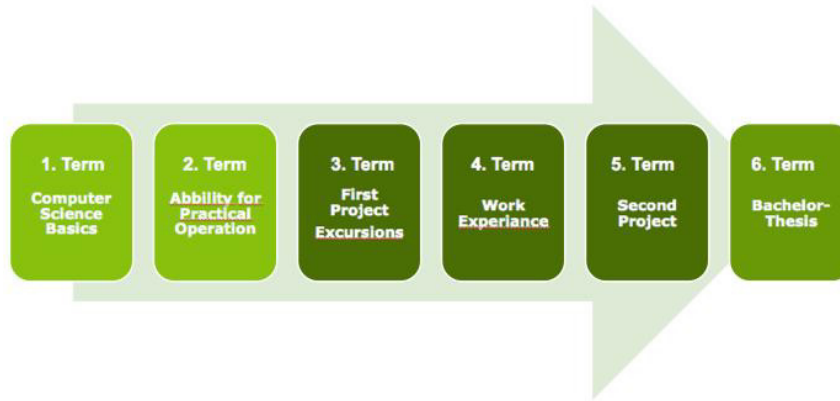


Fig. 2. More practice with semesters growing

In the third semester, the core subject is the industrial project (see following section). Here the first specialization takes place. By working on one of the projects, the students gain and apply knowledge how to build a certain software product, together with advanced students (typically from fifth semester). Working in projects also means working together in teams and building up something over more than one phase of the software lifecycle. It is a specialty that already the third semester students are participating in these external projects. As this is relatively early in the degree program, supporting management and soft-skill courses, such as 'project management' and 'conflict management' are held at the same time, allowing the knowledge to be applied directly.

Supporting IT-lectures are provided for application areas such as web technologies, IT security and databases. Another part of the third semester is the excursions. Throughout the term we visit at least six different IT companies. During 3-5 hours, the companies have the possibility to present on-going projects, possible career paths, or to provide a tour through the company to give an inside into the working atmosphere and the business culture. The visits encompass large companies, as Deutsche Telekom, Siemens and IBM and small and medium ones, such as Zalando, Idealo, init AG, immobilenscout. The students embrace these events as they offer the chance to get insides and to ask questions, which help them to decide for an internship or a possible employer.

3. The Projects

As a result of the first evaluation and accreditation process, the practical projects have become something like the backbone of the study programme. Every year, 10-12 different projects are realized.

3.1. Intentions and Comparison

The idea to have projects within the curriculum is not new. In almost every computer science programme a project provides the opportunity to apply learned knowledge. These "usual" projects are often typical in some aspects: There is mostly one big (at least one semester) project, which often concludes the studies and hence, takes place late in the programme. In the majority of cases the same objective is processed in parallel by different teams. Thus, in best case, the result is used only once in practice. Sometimes the objective itself is designed artificially and does not correspond to a practical need. The role of the customer is then taken over by the lecturer. The team members have a similar knowledge base, i.e. come from the same semester.

The projects conducted within our programme are strongly aligned to real-life demands and are special in several ways. In order to establish a lifelike setting, regional companies are asked to be stakeholders (customers) in the projects. The companies as well as the projects represent the wide range of possible working areas within the IT-sector (c.f. (Computer Science and Business Administration, 2014)). The projects are conducted twice within the curriculum. This provides the possibility to learn from the first run and to improve the project performance in the second time. The teams are mixed, consisting of students from different semesters. As in normal projects, such a

setting enables an exchange of experiences and knowledge between the team members. Furthermore, the early project (third semester) forces the students not only to apply existing knowledge, but also to acquire the needed expertise on their own. Because of the real-life situation (i.e. a customer, who wants to use the results afterwards), the motivation of the students is very high.

3.2. Implementation

The project teams consist of 5-7 students from the third and fifth semester. The teams are set up at random. Lots are drawn to build the teams, which consist of as many students from third semester as from fifth. Self-chosen teams have been tried first, but randomly build teams appear to be more realistic, as they are more heterogeneous and offer a more professional teamwork right from the beginning. The clients, the stakeholder from industry, present their project (tasks, contact persons and organizational framework) at the beginning of the semester and the teams choose their favourite project short after that presentation. Conflicts between teams interested in the same project are solved by mutual agreement or by lot. During the term, the teams work autonomously. The involvement of the industry partners varies from some workshops throughout the semester up to weekly meetings within the company. The lecturers accompany the projects only in the role of a program manager, i.e. bi-weekly meet the project managers and possibly help or escalate if difficulties arise. To keep track of the results, a midterm and a final presentation are organized. At the end of the semester, the results are presented as part of a fair - open to all students and stakeholders. This event is concluded with a joint party - organized by the first-year students - that celebrates the reached learning progress. The best projects again gather attention, as they are presented on a competing event of all university's computer science study programs later in the year.

3.3. Outcome

The profit for both sides – companies and students – is obvious: The companies are brought into contact and obtain first impressions of a group of future IT graduates. Additionally, these students gain first-hand experience and can familiarize themselves with the working conditions and requirements of these companies and are therefore valuable potential new employees. The students are given the possibility to work on real projects, improving their professional skills – both technically and socially. The participation of second year students in the external projects is a challenge. However, the lack of experience is often compensated by a higher motivation caused by the 'real' project setting. Furthermore, obstacles or even to some extent failures are valuable and can be used to improve the second project in the third year: It shows that the attitude of the fifth semester's students within the projects is much more offensive and target-oriented due to the former experiences. The younger students are more nervous but get the support of the elderly. This way project members from different years can profit and learn from each other (Stout, Dasgupta, Hunsinger, & McManus, 2011).

An additional advantage for the students is, that they can find a potential company for the internship to be completed in the fourth semester; or a company for their bachelor thesis in the sixth semester, respectively. It is an additional side benefit, that the students are more self-confident when applying for jobs or internships due to the knowledge and experience obtained with the projects. Most of the students refer to their projects in their application documents, giving them a competitive advantage compared to other applicants with a lack of such experience.

The various projects with mostly persuasive results as well as the reliable contacts with small, middle and large companies or non profit associations and institutions also impact the internal and external perception of the whole study programme, leading to a good reputation of the study course. Thereof the students and its associated professors profit as well.

4. Conclusion

It is now seven years since the mono-educative study course 'Computer Science and Business Administration (Informatik und Wirtschaft)' was brought into life. Since then, around 40 students have registered for the programme each year (reaching the limit of places). This has led to an increase in the number of women studying

computer science at the HTW Berlin. A measurable indication of the actual boost in female IT-students are the steady numbers of female students in other IT programmes at the university, which did not diminish. In fact, the opposite has happened: the number of women in other IT programmes has increased. One speculation about this effect is, that the promotion of the women's programme or just the knowledge that such an offer exists, has encouraged women to study IT at the HTW Berlin.

The curriculum - and in particular the projects - shows that it is possible to combine high education goals of an IT degree programme with the interests and the lifestyle, such as time management, of young women and mothers. This only acquires the will, the creativity and the flexibility of the professors to find solutions for the target group. In case of the projects this is a win-win situation for both sides - the students and the companies. Additionally, a practical approach is what women are especially interested in. So this should be a good example for further gender sensitive curricula.

Overall, it can be concluded that a mono-educative degree programme is successful if the curriculum is structured according to the needs and expectations of the target group and differs from the mainstream degree programme. It appears that the degree programme encourages women to study computer sciences who never thought they would ever study such a subject. However, it is not intended to establish a consecutive, mono-educative master programme. The self-confidence of the graduates suffices to join "normal" master programmes. How the programme can be improved, what we can learn from the programme or how the concept could be transferred to other programmes should be discussed and further discovered. For this we are in close contact with our students, alumni, and partners from industry.

References

- Computer Science and Business Administration. (2014). *Projects*. Abgerufen am 16. 01 2016 von Projects: <http://fiw.htw-berlin.de/studium/projekte/>
- Corsun, D., & Costen, W. (March 2001). Is the Glass Ceiling Unbreakable? Habitus, Fields, and the Stalling of Women and Minorities in Management. *Journal of Management Inquiry*, 10 (1), S. 16-25.
- Hochschule Bremen City Univ. of Appl. Sc. (2016). *International Women's Degree Programme in Computer Science B.Sc.* Abgerufen am 16. 01 2016 von International Women's Degree Programme in Computer Science B.Sc.: <http://www.hs-bremen.de/internet/en/studium/stg/ifi/index.html>
- Margolis, J., & Fisher, A. (2003). *Unlocking the clubhouse - Women in Computing*. Cambridge: The MIT Press.
- Stout, J., Dasgupta, N., Hunsinger, M., & McManus, M. (2011). STEMing the Tide: Using Ingroup Experts to Inoculate Women's Self-Concept in Science, Technology, Engineering, and Mathematics (STEM). *Journal of Personality and Social Psychology*, 100 (2), S. 255-270.