Girls only class in computer science at the upper stage secondary level

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ABSTRACT
This paper describes the establishment of a girls only – class in computer science at the upper stage secondary level at the Gymnasium Sulingen (grammar school). We concentrate on the motivation, the side conditions considering the latest reforms in school education in Germany and the feedback by the pupils.

Keywords
Girls only class, computer science class

PRELIMINARIES
In the year 2000 the International Women´s Degree Programme in Computer Science [5] was established at the Hochschule Bremen (university of applied sciences) as the only single sex programme in computer science in Germany. The programme was funded by the German Federal Ministry of Education and Research and the Federal State of Bremen during the first 5 years. After the successfull evaluation by external scientists in 2005 the programme now is established as a regular study branch at the Hochschule Bremen. The major interest of the International Women`s Degree Programme ist the recruitement of young women not only as users but as developers of high technology. For this aim young women ´s interest in information technology and their technical self-esteem has to be raised at school age already.

Are there characteristics of those young women who might become successfull computer scientists? The scientific evaluation of the International Women´s Degree Study Programme [1] yields some common properties and attitudes of the students: The programme attracts young women with a solid self-esteem concerning their technical potential, but with doubts about their deeper computer science knowledge.

The evaluation considers only young women who finally decided to study computer science. Of course it´s even more important to know why young women do not decide so. The study [3] yields deeper insight in the reasons for the non-selection of natural sciences, maths and technical sciences: As a matter of principle there seems to be a strong continuity between a pupil´s main interests at school and the selection of a study programme. For all disciplines the probability to select a certain study programme increases with the results gained at school and the teaching quality at school in the corresponding fields (as perceived when looking back retrospectively). The higher someone judges his knowledge and skills in a certain field the higher is the possibility that he decides for the corresponding study branch. Given the same levels of technical competence and the same marks at school young women do decide far less likely for a technical study programme. Young women especially doubt their preparednes for these studies. [3] draws the following conclusion: In order to attract young women to a career in natural sciences, mathematics or technical sciences the corresponding classes at school have to be improved, for example by introducing temporary single sex education.

COMPUTER SCIENCE CLASSES AT THE GYMNASIUM SULINGEN
Following the above mentioned recommendations the aim is to establish a girls only computer class at the upper stage secondary school. Education at schools in Germany is regulated by the recommendations of the Ministers of Education [6]. The last reforms that have been introduced in 2006 reestablish the importance of mathematics, German and one foreign language at school. As an effect it becomes harder for grammer schools to offer a broad range of preparatory science courses in other disciplines (like technical sciences for example) [4].

The Gymnasium Sulingen [2] belongs to MINT-EC, an association of centers of excellence in maths, natural and technical sciences at schools [7]. The Gymnasium Sulingen continously offers computer science classes at the upper stage secondary level. In 2006 there were 11 pupils joining these classes, probably too few to continue the classes after the reforms introduced in 2006 [6].

Instead of stopping computer science education at the upper stage secondary level the school decided to offer computer science classes not only to pupils with a profile in natural sciences and mathematics. Additionally the classes were opened to pupils with a profile in social sciences as well as to pupils with a profile in arts. This procedure reflects the conviction that computer science is interesting and attractive for people with different backgrounds. In 2007 computer science classes were chosen by 35 pupils, thus supporting the school´s schedule.

The pupil´s decisions backed the idea of offering a girls only class in computer science in 2008 – to be taught by a lecturer of the International Women´s Degree Programme in Computer Science. After announcing these plans to the pupils 75 of them decided for a computer science class. 50% of them have got a profile in natural sciences and maths, the others in social sciences. The rate of girls raised from 30% in 2007 to 50% in 2008. Because of this great interest a girls only class can actually be established. Following the central German recommendations on the final exams the class will deal with computer design and architecture and programming (in Delphi). This content corresponds to what the Bremer students identify as their main deficiency in prior knowledge.

COURSE STRUCTURE

The girls only class in computer science established at the Gymnasium Sulingen in autumn 2008 consists of 22 girls in the age of 15 to 16.

The course starts with an introduction to finite automata. The pupils use them to model different real world examples. Properties of finite automata are investigated, thus connecting the lessons at school to theoretical computer science. Basics of computer design and architecture offer a first glance at technical computer science. All lectures are completed by practical exercises done by the pupils. This work can be achieved alone, but the girls are encouraged to work in teams.

The second part of the course provides first experiences in programming. The pupils design algorithms and implement them using the programming language Delphi. Questions like „What can be done by computers?" and „What should be done by computers?" link computer science to its social implications.

The content of the single sex class doesn´t differ from the content learned in the coeducative class. But the learning styles of girls and boys tend to differ: Most girls work very systematically whereas a significant percentage of the boys

prefers to work by trial and error. This procedure sometimes leeds to surprising and impressing quick results that intimidate others. At the Gymnasium Sulingen the systematic approach to problem solving is strongly appreciated and the limits of trial and error are shown. In the single sex class team work is emphasized.

EVALUATION

After the first six months the computer science classes at the Gymnasium Sulingen were evaluated. Additionally the single sex class answered some questions that were already used in the scientific evaluation of the International Women´s Degree Study Programme [1].

The questions are as follows:

1.   How do you judge your computer science knowledge before starting the course and now?

2.   What is your opinion on the lecture (motivation, importance, comprehensibility, examples, structure, treatment of questions and pupils)?

3.   Why did you join a single sex computer science class? Do your expectations fit to your experiences in the lecture?

4.   How do you rate the single sex class? How do your friends (from other classes) rate this class?

5.   What is your opinion on single sex education?

The pupils judge their knowledge and abilities in general computer skills, in applications, in computer architecture and in the internet (1 very bad to 5 very good) as it was in the beginning of the course and as it is now.
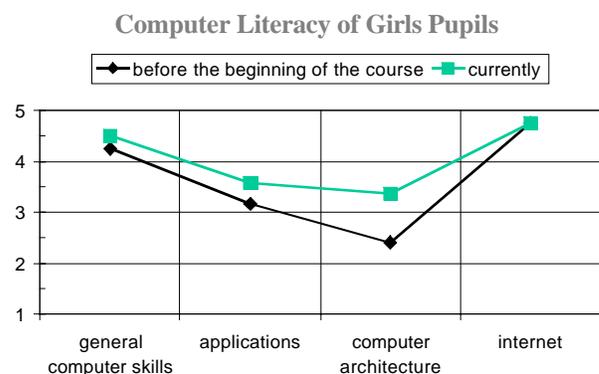
Fig.1: results of a self-evaluation survey of computer skills taken by girl pupils before the beginning of the course and currently.

The girls have been and still are confident in their technical abilities and general computer skills and the internet. They think their knowledge in computer architecture and applications has improved

This result resembles to the result of [1]: Students studying in the International Women´s Degree Programme as well have got a solid self-esteem concerning their technical potential, but they doubt their knowledge in concrete topics of computer science.

The opinion of the girls on their computer science class is summarized in the following figure. Criteria considered are: motivation and importance of the content learned, structure of the lecture and quality of the examples used, effort necessary to suceed in the class, quality of the interaction in the classroom between lecturer and pupils and pupils with each other (1 very good to 5 very bad).
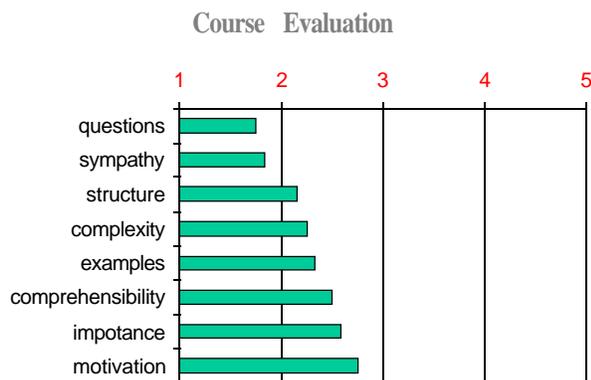
Course Evaluation

Fig. 2: results of course evaluation (1 best to 5 very bad).

The evaluation yields good results. The criteria „motivation" gets the worst mark – maybe partly because the computer science class takes place on friday afternoon. The best marks are given to „sympathy" and „questions", thus appreciating the emphasis given to team work and to an open and non-competing atmosphere.

Figure 3 shows the motivation for joining the single sex class in computer science. Before the start of the class the interest in computer science was the most important reason. During the last months the interest in computer science didn´t change but the social connections in this special class gained importance. As well the positive learning conditions turned out to be more important than expected by the participants. Once again this result resembles an insight gained in [1]: Students studying in the International Women´s Degree Programme highly estimate the familiarity with each other.

Motive Satisfaction Score
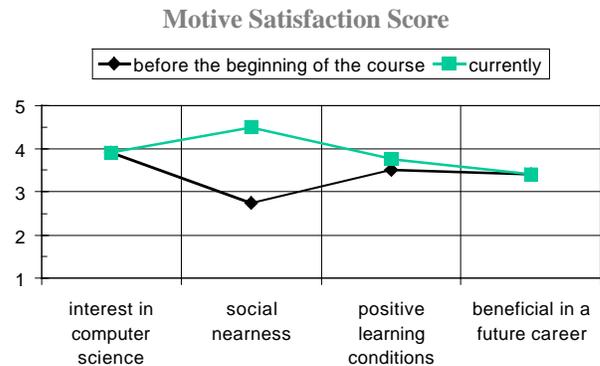
Fig. 3: motive satisfaction before the beginning of the course and currently (1 very bad to 5 best).

How do you rate the single sex class? How do your friends (from other classes) rate this class? The question for acceptance of the girls only class yields the results shown in figure 4. The general opinion on the class doesnt´t differ much between participants and non-participants. One reason for the slight difference maybe that fellow pupils don´t know the special atmosphere in the girls only class.

The evaluation [1] showed that some students in the International Women´s Degree Programme are afraid that their study programme might be less appreciated by others than a study in a coeducative computer science programme. These problems seem not to exist at school level.
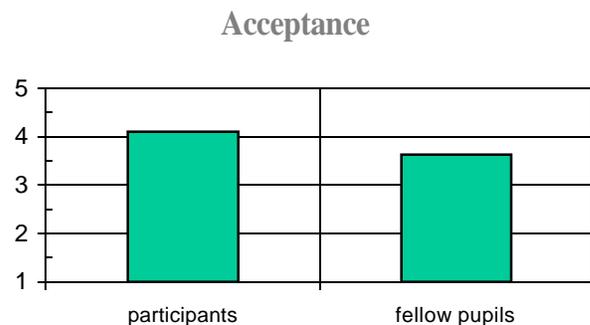
Acceptance

Fig. 4: girls only course acceptance among participants and fellow pupils (1 very low to 5 very good).

The pupils explained their opinion on single sex education by a short text. Most of them (60 %) emphasized that they felt encouraged to ask any kind of questions on computers and that they didn´t fear to be ridicolous by not knowing

something. They think that this relaxed learning atmosphere is due to the single sex class taught by a female lecturer. A strong minority (10%) would prefer a coeducative class next time

SUMMARY

Computer science knowledge is required in different professional areas. Therefore computer science classes should be offerd to pupils with different ideas concerning their future professional life. The schedule developed at the Gymnasium Sulingen attracts equally girls and boys with different profiles. Having in mind the correlation between success and involvement at school and the decision for a corresponding study branch we hope to provide additional chances in the pupil´s future professional life.

The evaluation after the first six months of the single sex computer science class shows a broad acceptance by the participants and good learning results. Because of the increase of participants in computer science classes the Gymnasium Sulingen will establish computer science as one possible class in the final exams.

The cooperation between the International Women´s Degree Programme at the Hochschule Bremen and the Gymnasium Sulingen shows yet another way to enhance the participation of young women in technical sciences. Most other projects offer special courses for female pupils at the university or they send advanced students to schools

for information events or weekend classes (see for example [8]). The project described here differs: The pupils do not have to find their way to a university, but they get constant support for the whole term at their school.

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