

Yes she can! How to encourage girls to choose a career path in computer science

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Abstract: Women are still underrepresented in studies and in job positions in the fields of STEM. This paper proposes a study and a lecture concept as measures to increase the number of women in Computer Science careers. The study aims to better understand barriers, drivers and influencing factors that affect young women's decision for or against a career in computer science. A lecture series on computer science is proposed, specifically designed for girls and young women to reduce fears and prejudices and increase the visibility of women in IT. This will also provide further research data that will enable adjusting to the requirements of the target group based on the research outcomes. With this article, the authors would like to initiate discussion on how universities can better gear their offerings to a female target group.

Keywords: Women in STEM, computer science careers, female-oriented lecture concept

1 Introduction and State of the Art

Science, technology, engineering, and mathematics (STEM) are deemed as highly significant to any national economy and important fields of action of a government's high-tech strategy. An equal gender-based participation within these fields is an essential condition for the sustainable and future-oriented development of our society, because “diversity” is the key to creativity, productivity, and innovation [Ki05] [BU09].

Women are still underrepresented in education and in academic positions in the field of computer science. In winter term 2020/21, within the field of computer science, there were only 25.735 female students (19%) enrolled in studies of computer science in German Universities as opposed to 108.030 male students (81%) [St21]. According to current research, the reasons preventing girls and women to major in computer science are manifold: Cultural stereotypes, gender biases, and microinequities (subtle discriminatory behaviors) evoke a missing sense of belonging to these fields [CH15]; lack of female role models and mentors that provide support and encouragement; low level of self-efficacy, engagement, and perceived low practical relevance; missing gender-sensitivity in computer science classrooms and in the learning design [SOL20]. To overcome these barriers, there are many recommendations and initiatives on how to promote girls and women in computer

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science. These include measures like integrating technology and computer science education in the early stages of the curriculum (e.g. [GI19]), offering online coding platforms for all ages (e.g. Scratch, code.org), improving career counseling and orientation options (school and non-school activities) [Dr19] as well as setting up girls-only initiatives to provide creative and inspiring learning environments (e.g. Girls' Day, Hackathons for Girls). Current research also investigates how to make science and higher education more inclusive and accessible. Organizations such as „500 Women Scientists“ (<https://500womenscientists.org/>) specifically address women and gender minorities in STEM and launch initiatives such as supporting *mothers in science*, *women scientists with disabilities*, and conducting so-called Wikipedia Edit-a-thons in order to increase the visibility of women in STEM on Wikipedia.

2 Study on career choice drivers and barriers

Key factors for increasing STEM career interest are also linked to increasing the interest in these fields among elementary, middle and high school students [VW12], [Bu21]. While both girls and boys take math and science courses in school, and despite the similarities in their achievements, fewer women than men pursue STEM majors. This transition from high school to college/university seems to be a critical moment when many young women turn away from a STEM career path [HI10]. Based on these findings and existing experiences, further research is needed on how to encourage and support young women in deciding on a career path in computer science. Current work to perform a study seeks to answer the following research questions:

- What are barriers, drivers and key situations that affect girls' and young women's decision to enter the field of computer science?
- Who are the influencers for a career path in computer science?
- Which offers are already being used for career orientation and decision support?

The target group is female secondary school students (15 - 19 years) who are close to finishing their secondary school years and will be deciding their career path soon. Data collection will take place in May and June 2022 via an online access panel from a market research institute. An online panel is particularly suitable to find a representative sample for special samples e.g., a particular age group because the socio-demographic data is available upfront [DB16]. The targeted sample size will be approximately 1500 students. Screening criteria are used in the beginning of the questionnaire so that about 60% of the sample will have an interest in STEM topics. This is done to evaluate whether the answers of students with an interest in STEM topics and those without differ significantly. In addition, 60% of the sample should also be interested in higher education study to be able to evaluate whether students who consider an apprenticeship in a STEM area differ from those who seek a degree in higher education. A structured survey is used which combines mainly quantitative questions with a few qualitative questions to gain insights into the motivations, barriers, influencers and information sources for career orientation.

3 Lecture Series

To actively offer a personal and interactive way of informing about computer science, a lecture series for the target group was designed. It addresses current topics from computer science and related fields of study in the scope of six virtual lectures of 60min each. In a combination of theory and case studies, it will be explained how computer science impacts the daily lives of each of us. The objectives are to explain what computer science is, remove fears and prejudices, and increase the visibility of women in IT. The lectures are given exclusively by female professors from IU International University of Applied Sciences, who also talk about their own careers and are available to answer participants' questions. In addition, they feature female scientists and entrepreneurs who are active in the respective fields. By using interactive elements like online quizzes, observations or short surveys, additional data about motivation, self-awareness and image of STEM studies will be collected. The topics cover a broad range of fields of computer science and each has a significant message to be conveyed:

Computer science is *universal in its application*: We look at a typical day in a life of the girls and check, where there is "IT inside". What kinds of human computer interfaces do we use and how? What kind of data do we provide and what happens to it?

Computer science is *no magic*: What does a computer scientist do? What is programming? What is an algorithm? What does it feel like to work in IT as a female professional? What female strengths are important for this?

Computer science is *creative*: A computer scientist thinks out of the box and solves real-life problems in innovative ways. How can software help you to explore your digital creativity?

Computer science is *pure communication*: What is communication? Why do we need rules and protocols? How do computer networks work? How do we communicate with computers? And how does communication help us to develop better software?

Computer science *changes the world*: Computer science helps to optimize processes and products. What aspects of life would you like to improve?

Computer science has many interesting *research fields*. Which fits best for me? What's the difference between Applied Computer Science, Business Informatics, Artificial Intelligence, Cyber Security, Data Science, Digital Humanities, Robotics and Medical computer science? Where would you like to work and why?

As part of the planned series of lectures, the requirements of the target group will be continuously surveyed. From the study results and the additional findings collected during the lecture series, measures can be derived to help increase the representation of women in the study of Computer Science. Furthermore, the measures for addressing and providing orientation to the target group will be evaluated. In this way, the effects of the individual measures can be reviewed and adjusted if necessary.

4 Conclusion

The development of high-quality higher education for girls and women expands their career opportunities. This paper considered the underrepresentation of women in STEM and presented a proposal of a study and a lecture concept as measures to increase the number of women in computer science careers. The study aims to better understand the critical barriers, drivers, and key situations as well as influencing factors and relevant orientation offers that affect girls' and young women's decision for or against computer science as a major. The results of this study will give insights into target group needs and for designing appropriate course offerings in computer science. Also, the findings will be directly incorporated into the design of the lecture concept presented, aiming at positive associations and the reduction of possible barriers regarding a study in computer science.

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