

STEM Promotion to Empower and Support Girls and Women: A Cross-University Project in Austria

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Abstract

Unfortunately, women are still strongly underrepresented in STEM professions. This is not only evident in professional life, but already in the choice of suitable educational institutions and studies. There are many reasons for this, such as a lack of role models, gender stereotypes, and prejudices that are still strongly anchored in our society. To counteract this, measures are urgently needed and must be implemented as early as possible to awake interest in the STEM field. Once this interest has successfully been established, it is important to maintain it in the long term. This paper presents the "Girls Only" project funded by the Federal Chancellery, which is being carried out at the Johannes Kepler University (JKU) and is in parallel being researched. The project develops and delivers a seamless program of STEM support activities with a focus on computer science and computational thinking for girls and young women of all ages. The focus is on the specific needs of the relevant groups. The activities include workshops, labs, and regular courses on various topics for all girls of kindergarten and school age. An IT club promotes the talents of highly talented girls. A series of training activities and further education for educators are carried out to support their work in awakening girls' interest in STEM. A mentoring program and platform for female STEM students will be implemented at JKU and partner institutions. To strengthen this program, a qualitative survey with female pupils and students will be conducted to find out how to strengthen girls' interest in STEM fields, how to promote them and what needs girls and young women have in order to remain in the STEM field. The aim is to form a (cross-university) network to support and promote young women.*

Keywords: STEM education, mentoring, talent development, women empowerment

1. Introduction

Despite great efforts in research and teaching as

well as the high quota of women in the public and private sectors, a gender gap can still be observed in the IT sector [1, 2]. This leads to a lack of women in IT professions and studies. The reasons are manifold and range from a lack of interest shown by girls to still-existing stereotypes or misconceptions of computer science to concrete differences in the self-concept and performances of students [3]. Studies show that girls have lower self-confidence [4, 5] and lower interest [4] in school computer science than boys. However, girls' interest in STEM is quite high - but not in the classroom. Despite different projects, these problems of STEM teaching and gender differentiation have not been solved. Even so, women have great potential in the STEM field: the different perspectives of women can, for example, improve technological development in areas where companies have previously overlooked women and their needs.

At universities, this demand for diversity and the promotion of equity and inclusion has become a strategic task. At JKU equality in educational and professional opportunities is strategically promoted with a special women's advancement plan [6]. In terms of education, this plan enriches both women's access to academic studies and the active promotion of female students. This approach is very important but does not help if stereotypes and misconceptions about computer science are built up as early as kindergarten. To counteract this, it is necessary to start promoting computer science skills as early as possible. With a playful and age-appropriate approach to computer science at a young age, this is reduced or prevented.

2. Status Quo in Austria

There are various offers in Austria to get girls interested in STEM subjects. For example, the FIT-Project (A German acronym for women in technology) FIT ambassadors come to the schools and present the girls with scientific and technical studies and their professional field. There is also the

opportunity to receive individual advice at JKU Linz and to take part in company tours in Upper Austrian technology companies. On Girls Day, a full day in April, around 150 companies, training centers, and institutions throughout Upper Austria open their doors to bring girls interested in technology closer to their craft. The offer is aimed at girls between the ages of 5 and 14, as it is also important here to encourage curiosity as early as possible and to reduce any fears of contact. According to the project goals, early recognition of affinities apart from “typical” women’s jobs should strengthen self-confidence and pave the way for future training. The website of the MUT project (a German acronym for MUT – girls and technology) offers a collection of web addresses that are intended to support girls who are enthusiastic about technology in their further development and to avoid stereotypes when choosing a career. The project ADA (ADA - algorithms think differently, inspired by Ada Lovelace) offers a series of workshops at schools with “Diary of the computer scientist”, in which schoolgirls can get an insight into computer science and life as a computer scientist in direct discussions with experienced computer scientists. The goal here is to address the barriers that arise from computer science and a negative perception of the daily reality of a woman in science. The Science Holidays at the JKU Linz offer girls and boys between the ages of 6 and 14 insights into various research areas during a holiday week. In workshops, seminars, and excursions, the topics of natural sciences, technology, law, medicine, economy, social affairs, and biology are dealt with. The Kinderuni (German for “children's university”) also offers courses for girls and boys in various MINT areas (and many other subject areas) every year during a holiday week. The offer is aimed at children and young people between the ages of 5 and 15 and depends on which scientists are willing to work with us. In recent years, special STEM courses have also been offered for girls, such as “Girls can do it!”, a course for girls on coding and app development. The Young Science Ambassadors of the ÖAD Young Science Project visit schools throughout Austria and report on their research field and professional career. This offer is aimed at an entire school class, regardless of the type of school and the age of the students. Talente OÖ (A German acronym for “Talents of Upper Austria”) offers courses and workshops for talented students from the 3rd grade upwards in various departments, including in the STEM area. Sometimes there are classes only for girls or young women, but also here it is depending on the scientists or teachers.

However, there still exist big gaps in the following aspects:

- Age: On the one hand, most programs do not start until school-age or much later. However, stereotypes develop much earlier. The best way to

prevent or reduce this is to offer children unprejudiced access to the subject as early as possible. Research also shows that it is more effective to arouse interest as early as possible [7]. It is important to start as early as possible because in primary education the interests of children are developed and can therefore be more easily influenced [8, 9]. Our project not only starts in the preschool sector but also extends seamlessly over all ages all the way to university. This enables girls and young women to be accompanied, supported, and promoted throughout their entire education. In addition, prospective pedagogues are trained to educate and teach girls and young women without prejudice, and to offer opportunities to get an insight into the STEM area as early as possible.

- Gender identity: Another important aspect is that our project is only accessible to people identifying themselves as female. In most of the other institutions' courses, there are joint courses for all gender identities. It has been shown that children who identify themselves as female hold back more and thus cannot benefit from STEM offers to the desired extent, deepening their interests and specializing in topics. That is why our offers are specially designed for people who identify themselves as female.
- Talent: Offers for gifted students in Austria are most often only available for students who got tested and scored very high on IQ tests. We want to promote children regardless of the tested performance potential. For this purpose, courses are planned that are accessible to children and young adults who identify themselves as female with different high abilities, which are promoted.
- Long-term: All existing offers so far only offer short-term support, some a single day a year, some a workshop over a limited period. In our project we want to accompany girls and young women on the one hand during their entire education, on the other hand, to enable continuous offers every year. An important goal for Girls* Only is to establish contact with interested girls and their parents and to maintain them long-term.

3. Girls* Only

The Girls* Only project started in January 2021 and lasts until 31st December 2022. The project aims to create a complete program of STEM support measures with a focus on computer science (CS) and computational thinking (CT) for girls and young women of all age groups, which is specifically tailored to the needs of the respective target groups. The Girls* Only project wants to take care of children in kindergarten age (elementary level), school children (primary and secondary levels), university students,

and young researchers who identify themselves as female. Moreover, there will also be support, assistance, and guidance for educators from the elementary level up to the secondary school level. Each of the target groups mentioned has its own needs and is therefore specially addressed. Girls* Only will develop and establish different offers for STEM promotion: a STEM club for Girls* Only (Girls* Only IT Club and Girls* Only Talente Club) where the children get insight into the STEM field, the STEM insight (German: MINT-Schnuppertage) where children and young adults get a STEM role model, summer topic classes with a focus in the STEM field, mentoring program by students in the STEM field or training for educators to motivate children to STEM without arousing prejudices, among others.

In order to achieve the desired changes in women's school, study, and career choices, the Girls* Only project offers a complete range of STEM support measures for girls and young women of all ages to stimulate interest in computer science in girls and young women awaken and strengthen. To this end, the girls and young women are supported and encouraged in their research interests, their digital skills, their creativity, their ability to work in a team, and their problem-solving skills. It is important to offer different and individual tasks for this target group so that everyone can consolidate their skills and talents and then expand them in other areas. This interdisciplinary approach enables the participants to develop their potential in the best possible way and to be open to new ideas. An important criterion is that the individual tasks motivate the participants in order to inspire them to further challenges. In the individual projects, the participants are confronted with problems in the STEM area in order to get to know the broad field of computer science and to understand the importance of computer science today. If you combine these concepts, you can prevent or at least minimize possible prejudices, misconceptions, fears, and inhibitions about computer science and new technologies. To achieve these goals, researchers from four different departments of JKU (STEM education, Business Informatics - Software Engineering, Gender and Diversity Management, and Educational Research) work together and offer their expertise. Additionally, other universities Montanuniversität Leoben (MUL) and the University of Passau) and technology companies (Dynatrace and Robo Technologies GmbH) are supporting the project.

4. Planned Research

For the evaluation, different studies are planned to investigate the following aims of the Girls* Only project: (1) strengthening of STEM competencies of children and young adults who identify themselves as female, (2) sparking and keeping the interest in the

STEM field of children's and young adults who identify themselves as female and (3) the promotion of gifted students in the STEM field who identify themselves as female.

The first survey is currently being conducted to find out what children and young adults who identify themselves as female need in order to get them excited about STEM and to encourage them. The questions are addressed to secondary school students as well as university students from the STEM field in Upper Austria and Styria. These participants will take part in the mentoring program of the project and will also be part of the evaluation of this program. At the end of the project in December 2022, a final evaluation of the mentoring and the workshops on the STEM support measures is planned.

5. The Girls* Only Project: Implementation and Dissemination

From March to December 2022 over 50 different workshops and lectures were offered:

5.1. Girls* Only IT Club

The Girls* Only IT Club [12] offered workshops, labs, and regular courses on different topics for all children of kindergarten and school age who identify themselves as females. Both courses and individual events for groups were offered. The club was a research workshop where the children could take on the role of researchers and developers and try out and use the latest technologies. They will have the opportunity to get a taste of real research projects, participate and learn about scientific work in the STEM field in practice. The fourteen workshops took place every 14 days on Wednesday afternoons at the JKU. Ten workshop units in the Girls* Only IT Club were conducted until the end of the project and will be continued in the following project "Let IT Dance!" in March 2023 [11], [12], [13], [14], [15], [16], [17].

5.2. Girls* Only Talents Club

The Girls* Only Talent Club [12] was designed to promote talent and aimed at children who identify themselves as female and are higher or highly gifted. Regular courses were offered for schoolchildren in which they gain insights into a wide range of STEM topics and could carry out experiments themselves. They could contribute their own ideas, implement individual solutions, and develop creative products. Seventeen workshops took place every 14 days on Wednesday afternoons at the JKU [12], [17].

5.3. Theater Workshop and Film-Production

In eight theater rehearsals and two units for produc

-tion, a film with important and current STEM topics was produced in cooperation between the JKU and two secondary schools (Kollegium Aloisianum and HTL1 Bau und Design). The film "A Royal Time Travel" was not only developed for the children, but the female students were the actors, and the students of the HTL did the direction and editing. The film premiere was on November 9th, 2022, at the JKU [12].

5.4. The Circus - Clear the Ring for Computer Science

The COOL Computer Science Circus [10] links selected core IT and STEM concepts with a circus show including interactive parts on side of a young audience, especially targeting young women. Alternatively, the circus show was transformed and held as a workshop, with different stations. In sum over 20 workshops took place from April 2022 until July 2022. The target group consists not only of primary school students aged 9–10 but also of primary school teachers. The circus will continue to exist as a performance or workshop beyond the end of the project.

5.5. Kindergarten Workshops

From October until December 2022, three STEM workshops "Experiment – Explore – Experience" (German: Experimentieren – Forschen – Entdecken) for kindergarten students (age 2-5) were held at the EKIZ Steyr. In these one-hour STEM courses, topics such as robots, the forest, and the element of water were playfully explored. The courses at the EKIZ will be continued and further developed beyond the end of the project in 2023 and 2024 [12], [16].

5.6. Counseling Sessions: Girls* Only Mentoring and Coaching

In over fifteen units of counseling sessions within our Girls* Only mentoring and coaching program with in-service and pre-service educators and students, important STEM topics and problems in the STEM area, training, and job were discussed. Three counseling units were held face-to-face and 12 via Zoom sessions due to the COVID-19 pandemic. The Girls* Only Mentoring program is an offer for children in school and university students (mentees) mentored by older and more experienced students or educators (mentors) in STEM fields. All mentors and mentees identify themselves as female. The mentor sessions were arranged individually by the mentor and mentee. In addition, the mentoring program was accompanied by professional workshops: on December 16th, 2022, two mentoring workshops took place in the morning and afternoon. As part of the first

workshop "STAND UP FOR YOURSELF" - conflict training for women in the STEM field, the participants learned strategies for dealing with conflicts using different methods from the fields of mental training, non-violent communication, and conflict management. Based on concrete situations, e.g., sexism in the workplace, possible behaviors could be played through and trained in order to be able to react in an emergency. As part of the workshop "Career Entry and Career Paths", the participants decided for themselves which priorities they would like to focus on the topics "Application process, career entry and career planning" or beyond. Tips were given about the application process, career entry, and career planning, and the women were told what the Upper Austrian family business plans to win over significantly more women in the future.

Regarding Girls* Only coaching, students of higher semesters and professors from the STEM field who identify themselves as female held ten micro-coaching sessions targeting STEM topics, especially basic IT concepts.

The mentoring and coaching program will remain at the MUL and JKU beyond the end of the project. Furthermore, both institutions are even trying to extend the duration of a mentor-mentee connection.

5.7. Summer Theme Workshops and Classes

During the JKU Science Holidays, several summer workshops with female primary and secondary students took place from the 11th to the 29th of July 2022. The offer was like the Girls-Only* Club but designed as a block event (duration = 1 week) in the summer holidays. It was a mixture of various STEM topics related exercises, such as tasks with robots (Ozobots and Beebots), and "CSI Informatics", with fingerprint examinations and analytics.

The four Summer Theme Workshops on Children's University at the FH Steyr, targeting 4-9-year-olds elementary and primary level children, included tasks with the Beebots, Ozobots, and the circus performance with a station learning fair of the circus "Clear the Ring for Computer Science".

Networking with important women in positions regarding business and industry in the STEM field, was also a main part of the Girls* only project because the support and advice, as well as discussing problems, are especially important at the beginning of the degree program. In the later course of studies, the goal of forming networks of young researchers and contacts in business and industry is important. Within the framework of Girls* Only, the first version of a digital platform is to be created to provide information and the possibility of networking between female university students and researchers. Female Professors should enable their female students to get in touch with the institutes so that they can work on research projects there. In this way, students can also

be recruited as future doctoral candidates. Young researchers should be able to network both within the university and across universities. Here too, professors can act as mentors who support young researchers and provide advice on problems. Building networks and contacts with businesses, industries, and other universities are also central to further career planning. Based on the “STEM Café” (German: “MINT Kaffee”) of the Women's Network of the University of Passau [11], a “STEM women's café” will take place once a month at the JKU from mid-December 2022. This informal meeting serves the exchange, networking, and getting to know important and influential women in the STEM field [12], [14].

5.9. Teacher Training

Furthermore, in the Girls* Only project two additional training for primary and secondary in-service and pre-service teachers were offered on various topics, such as the integrative implementation of the curriculum of digital education or e-didactics, in order to arouse interest in STEM topics. The developed materials for the training will also be permanently integrated into the JKU Material Exchange after the end of the project [12].

5.10. STEM insight – MINT Schnupperrn

With the Girls* Only STEM insight, children and young adults who identify themselves as female could get to know, interview, or accompany STEM role models from different universities for a while (also online), depending on their interests. They were able, for example, to get a taste of courses, experiment with different STE tasks at the STEM COOL Lab fair (9th November 2022), or also look over the shoulders of female technicians to gain an impression of various professions in the STEM field. The “MINT Schnupperrn” will continue at the JKU and MUL even after the end of the project [12].

5.11. Girls* Only Network Meetings and Dissemination Events

During the project, several events and networking meetings took place. On October 21st, 2021 the Project Girls* Only started with the “Kick Off” Event [12], [13] at the JKU with all project partners. Within this first meeting, the project objectives and activities were determined. In the first networking meeting at Montanuniversität on May 24th, 2022, all project partners met again and got in touch with other interested parties. There was also an exciting panel discussion on the topic of “Women in Technology”, and over 100 students of the MUL attended this event. During the first Network Meeting at the JKU on July 4th, 2022, the current status of the project and further

activities, such as the mentoring and coaching program, were discussed. On the 9th of November the second network meeting and event, also including a panel discussion with over 120 lower and higher secondary school students, took place [12]. Furthermore, at this event, the film premiere “A Royal Time Travel” took place. On December 5th, 2022, the last networking meeting with all partners and the closing event at the MUL took place. During the event “Female Empowerment” [12], [14] four mentors and mentees talked about their personal experiences within the Girls* Only mentoring program at the MUL. Furthermore, all partner presented their project results, such as the mentoring program, workshops, coaching, and training.

At the end of the Project in December 2022, a final evaluation and final report of the project are planned.

6. Conclusion

The Girls* Only project, in cooperation with the JKU, MUL, University of Passau, and Robo Wunderkind, was a very successful and multifaceted project. There were over 50 different workshops for pupils, students, and teachers, and over 20 group and individual counseling sessions within the coaching and mentoring programs in Linz and Leoben. Within Girls* Only, the project participants succeeded in creating a complete STEM funding program and establishing it in the long term beyond the end of the project. Of course, a one-year project is not enough to close the gender gap permanently, but it is a sustainable start, and a big step towards equality of all genders in Austria. In addition to the continuation of many workshops resulting from the project (e.g., Girls* Only IT Club, Clear the Ring for IT), the newly developed and adapted materials will also be made available to all educators throughout Austria as an Open Educational Resource (OER) on the JKU Material Exchange [12].

In addition, the MUL, the University of Passau, and the JKU applied for further programs for the advancement of women in 2023. At the JKU, the next women's promotion project will start at the end of 2022 to December 2023: “Let IT Dance!” [15]. That is why further steps will be taken in 2023. The mentoring program launched in cooperation with the MUL will be evaluated from 2023. A further evaluation is planned via the summer workshops and Clear the ring IT. There are also talks about the Mini Minz Clubs [12] and EKIZ [16].

Finally, it should be emphasized how important girls and women are in the STEM area, specially tailored projects such as Girls* Only, not only in Austria.

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