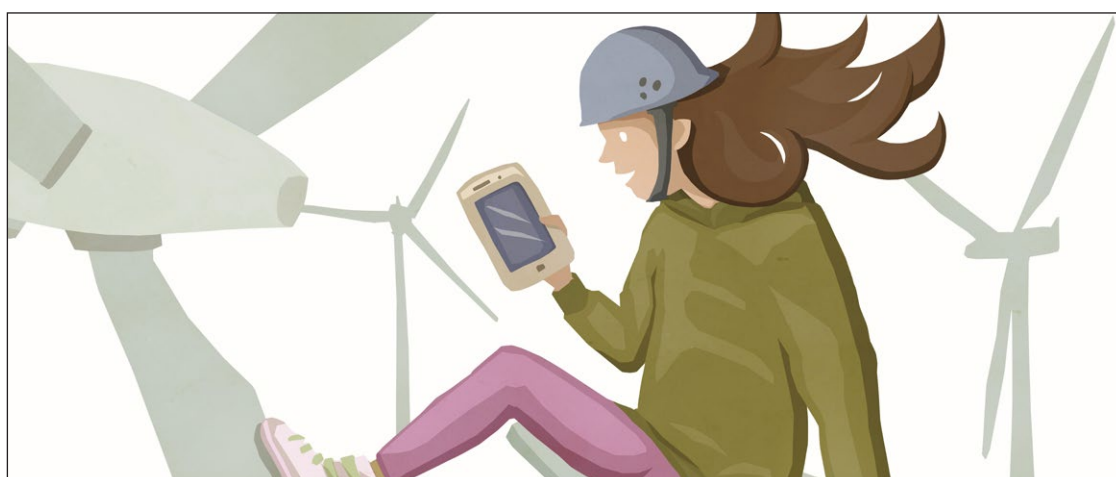


4.14. Serena

Project	Serena – Serious Game for Girls about Renewable Energy Technologies
Organisation	Bonn Science Shop (WILA Bonn), Technical University of Dresden and Game Studio the Good Evil
Cooperation partners	Realschule Neuss-Holzheim and Oberschule Johann Wolfgang von Goethe Heidenau, female gaming community
Research location	Bonn, Dresden, Köln, Germany
Team	Five researchers, two professors and two game designers
Funding sources	German Federal Ministry of Research and Education
Website	http://serena.wilabonn.de

ORGANISATIONAL BACKGROUND ●●●

Since 1984, Bonn Science Shop has been working on key social challenges. The present research project is a follow-up to the Ph.D research carried out by Pia Spangenberg. She is now collaborating with her colleague, Iken Draeger, and two other researchers (one full professor and one researcher) from the Technical University of Dresden in the field of Psychology of Learning and Instruction and three researchers (one full professor and two researchers) in Vocational Didactics from the Technical University of Dresden. A private company (the Good Evil) with two game designers is developing the game.

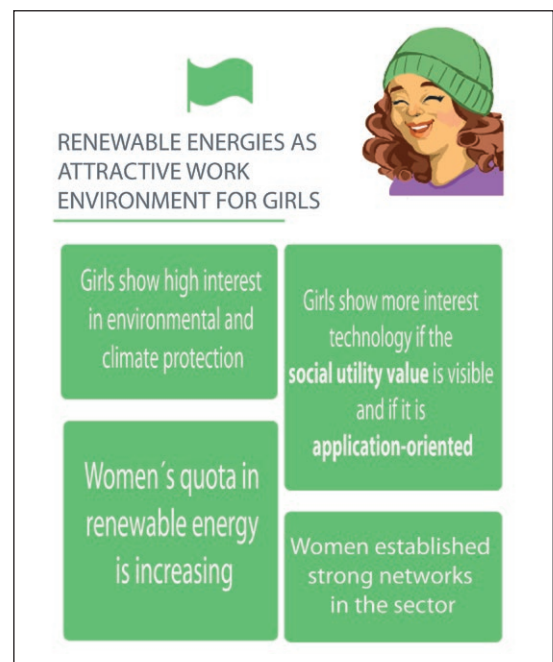
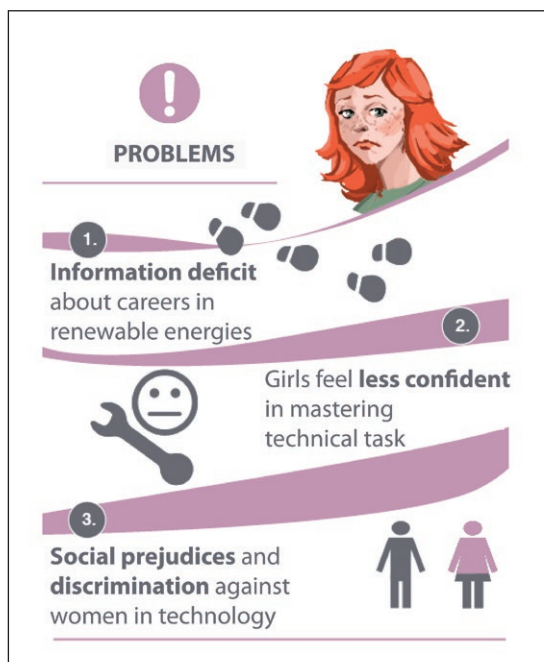


FUNDING ●●●

Bonn Science Shop is a non-profit organisation, working on a cost-covering but not profit-oriented basis. The institution as a whole receives no official funding. It only receives regular part-funding for its Education Centre because – according to the Landesweiterbildungsgesetz NRW (North Rhine Westphalia Land Further Education Act) – it is an accredited institution for further education and training. The Serena Project is funded by the Federal Ministry of Education and Research (BMBF).

PROBLEM BEING ADDRESSED ●●●

In Germany and other European countries only a small number of women work in technical professions. The percentage of women in technical vocational training in Germany is less than 10%. Due to the fact that women face various challenges regarding the choice of a career in a technical field including discrimination against women, lack of self-confidence in this field, less family support, minority status in a male-dominated work environment as well as societal gender role stereotypes, the percentage of women remains low. Occupational segregation matters because it is a conduit for the disadvantage facing women in the labour market and limits women's choices, impacting their potential for financial independence across a lifetime.



RESEARCH DESIGN AND SOLUTION ●●●

The question concerns what can promote girls' interest in technical vocational training. Previous research has shown that the social utility value of technology can spark the interest of girls in a technical field. This needs to be illustrated and explained. Girls are also thought to care more about the environment. The Serena research project is therefore pursuing the goal of providing 13-15 year old girls with opportunities for:

- acquiring knowledge and competencies regarding technical vocations,
- mastering typical tasks and challenges in the vocational field of renewable energy technologies,
- attracting and growing girls' interest in technical vocations as well as
- developing and increasing their confidence in their technical abilities by playing a serious game.

A serious game is a computer game which communicates knowledge that isn't forced upon young people while also being playful and fun. The serious game will provide girls with opportunities to explore the exciting working areas involved in technological occupations, and in doing so, to master typical challenges facing technicians in the renewable energy sector, including

discrimination in a male-dominated working environment. It will also provide opportunities for identification. Players will take on the role of an avatar – a girl that lives a typical teenager’s life. During her life she is confronted with technological problems which she has to solve together with her friends. The game will not be a simulation game but more of an experience game with elements of self-evaluation, which most importantly is fun to play. The method is based on the ‘value expectancy model’ (Eccles and Wigfield, 2002), which describes a method of stimulating self-reflection to strengthen the self-concept of one’s abilities. Game levels will start easy, with tasks such as changing a light bulb, but as the game continues these become more difficult. The design of the game addresses a number of trade-offs. The first is the balance between serious content and entertainment. What should be implemented in the game? How many objectives should be addressed? Should the game be more fun to play and not too complicated, so that it can be used in group discussions in class? The second is the balance between the level of participation and engagement versus the level of privacy. Some media are more appropriate for interaction with target groups and do not interfere with the privacy of participants (Snapchat/WhatsApp).

The final game will be evaluated to answer the research question: how can girls be attracted into technical vocational training in the field of renewable energies by playing a serious game? Design and evaluation is done in close collaboration between the Bonn Science Shop, the Technische Universität Dresden (Psychology; Vocational Education), the game studio The Good Evil and girls (aged 13 to 15) in two partner schools, using different research approaches:

- Qualitative analysis of current demands in the job market and of core competencies in the field of renewable energy professions.
- Online survey to investigate students’ preferences regarding the design features of the avatars that will be implemented as player and non-player characters.
- Online survey to investigate teachers’ preferences regarding usability in class.
- Development of formative and summative feedback strategies on the basis of the Interactive Tutoring Feedback model.
- Empirical evaluation study among girls to examine the effects of the feedback strategies on girls’ confidence in mastering technical tasks, their interest in technical vocations and their knowledge of technical vocations.



Pedagogic concepts for teaching material will support teachers using the serious game in class. The game can be used as a tool by teachers, parents or other initiatives focusing on promoting girls’ interest in technical professions. The project has both scientific and applied significance because it combines a design-based research approach to develop a serious game that aims at addressing the under-representation of female adolescents in STEM (Science, Technology, Engineering, Mathematics) through improving their confidence in mastering technical tasks.

GRAND CHALLENGE BEING ADDRESSED ●●●

Women are under-represented in technology-based occupations in Germany and other European countries. This is hardly changing in spite of a high number of initiatives to promote participation of girls in STEM occupations. Among various reasons for the lack of women in technology careers, a negative self-concept of technical abilities caused by unfavourable technical socialisation starting from birth has been identified as a major barrier hindering girls from choosing a technology career. Norms in society make it hard for girls to identify with an occupation that is not considered as feminine. Thus, the main challenges of the project are to:

- find an approach to make girls feel more self-confident about technology,
- take away the prejudices of society towards girls and technology and
- provide more information about careers for girls in renewable energies.

Since there are different types of girls and individuals may be social value or technology orientated, they have to be motivated in different ways. Their career decision-making process has to be understood to change subconscious gender role stereotypes by playing a serious game. A bottom-up approach therefore had to be developed to help girls to learn more about technology, its social utility value and how it can be used. Even once qualified, women tend not to pursue a technology career because it is a male-dominated working environment. While the game itself cannot solve that problem, it can contribute to the dialogue about discrimination against women in technology.

RESPONSIBLE RESEARCH AND INNOVATION ●●●

The Serena research project was initiated by Pia Spangenberg's thesis about women's career choices in the wind power industry. She interviewed thirty women and men employed in the industry. The results clearly showed that sustainability has a stronger subjective significance for career choice among women than for the men who were questioned. Together with Marcus Bösch (Game Studio The Good Evil) she developed the idea of a serious game for girls using her results. Partnering with the Technische Universität Dresden, the game studio The Good Evil and two state schools the project idea received funding from the German Federal Ministry of Research and Education. At the beginning of the project a science workshop in Berlin was organised to understand main issues in this research field and involve the relevant stakeholders such as gender experts, teachers, role models and vocational didactic experts. More importantly girls (aged 13 to 15) had to be involved in development of the game. Partnering with state schools, two workshops were carried out involving 120 girls, with more to follow, to gain insights into girls' experiences, preferences and knowledge in the field of renewable energy technologies. The collaboration with girls (aged 13 to 15) ensures that the final serious game will be accepted by them.

In addition to the interaction with girls, partnering schools and gender experts, citizens in society (female adolescents, teachers, multipliers, parents) are also involved in the game's development. A monthly newsletter, Twitter, Instagram and a blog help to stay in touch with the target groups, articulate the current status of the game, research results and initial tests on the game. By playing the first test levels and participating in online surveys, girls can give feedback such as design or story preferences. The types of questions are considered carefully, so that it is not too stringent but still serious enough to generate valuable feedback. Teaching materials will help to integrate the serious game into a syllabus or free time activity. The blog also introduces professions in the renewable energy industry and role models – young women working with

renewable energy technologies. Information is available for free and can be downloaded online. Over 220 girls have already signed up as game testers on a voluntary basis and have been involved in game design through contests, workshops and surveys.

The game design also draws on information from a variety of other people through building strong networks with existing institutions in the fields of gender and STEM:

- Psychology and learning studies to process the feedback and the individual's motivation
- Sociological research results about gender role stereotypes
- Job market analysis to design realistic work environments
- Technology companies to learn more about communicating with girls as future employees. One example is Solar World (Bonn), which is providing the project with insights about everyday work experience
- Employment agencies as multipliers
- Career orientation programs in the field of gender and STEM for dissemination
- Policymakers as a final target group to make them aware of the issues described

EVALUATION AND DISSEMINATION ●●●

A small group of young researchers are conducting the research, which is well embedded in scientific and applied communities. It combines a design-based research approach to developing a serious game that aims to address the under-representation of girls/women in STEM through improving their confidence in mastering technical tasks. The research has attracted the interest of schools and the national radio channel SWR2. Despite the small size of the group, dissemination to civil society is relatively extensive and the researchers have a strong presence in the scientific community. They have generated seven international journal publications.