

# The Roberta<sup>®</sup> Initiative

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**Abstract**—This paper gives a short overview of the Roberta Initiative – an approach to raise especially but not only girls’ interest in STEM (science, technology, engineering and math). Roberta comes with a didactic concept that uses robot construction kits in combination with a specialized didactic material and course format. Roberta teacher trainings and a European dissemination network are integral parts of the Roberta Initiative in order to establish a sustainable activity to raise girls’ interest in technical topics and in the end the portion of female engineers in Europe.

**Keywords**—component; educational robotics, robot construction kits, robot courses, teacher training

## I. INTRODUCTION

By designing, constructing, and programming robots, children can experience that working with technology is a creative and interesting but not a trivial process. The resulting hands-on learning environment helps them to acquire knowledge in computer science, technology and engineering. Additionally, constructing and programming robots in a teamwork setting is an ideal instrument to train those types of competences and soft skills that are essential for dealing with technical development processes. Many educational robotics activities - robot courses or robot competitions - rely on the fascination of mobile robots.

With Roberta the Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS) addresses the lack of (female) engineers in Germany and other European countries by raising children’s’ interest in technical professions. Roberta uses robot courses as a creative learning environment to teach knowledge in computer science, technology and engineering in an integrated, holistic way. The robot courses are tailored in a gender-balanced way, i. e. the didactic approach selects themes and experiments that are more interesting for girls but do not exclude boys. This is the specific approach and strength of the Roberta Initiative in comparison to other educational robotics offerings.

The Roberta Initiative comprises several elements which in combination constitute the basis for a sustainable activity to raise girls’ interest in technical topics.

- *Gendered didactic material* as a resource based on which certified teachers can design and assemble robot courses
- The *Roberta teacher trainings* as hands-on introductions to the employment of the Roberta didactic material. In

addition, they are the entry to join the Roberta teacher network.

- A *network of Roberta Regional Centres* to promote the ideas of Roberta on a regional scale and to provide certified Roberta teachers and Roberta courses in a region.

The following sections give an overview on these constitutive elements of the Roberta Initiative.

## II. ROBERTA DIDACTIC MATERIAL

In Roberta courses children first learn to get familiar with the building and programming of robots (simple task). The next step is to learn how to use different kind of sensors and programming languages (compound tasks). Simple tasks and compound tasks impart basic knowledge to construct, program and test a robot. Roberta experiments are based on the knowledge gained from Roberta simple tasks and compound tasks.

The structure of a Roberta experiment is as follows: After an introduction and explanation to a real world theme, usually taken from biology or nature, the concepts and structure observed in the real world are abstracted to a robotics experiment. Thus, the course participants have to analyze and understand a real world phenomenon. The next task is to model the phenomenon and to map it to a robotic experiment. This requires to analyze and to really understand a theme and its phenomenon. It is essentially a research step that is implicitly performed by the Roberta course participants. The intention behind is, that the course participants get a deeper understanding of a system and not only of a small part of it. Teaching to think on system level is a key motivation for our approach. Since Roberta courses are performed in a team environment, the course setting may be regarded as a simulated research and engineering process.

An example from the Roberta material is the experiment »Dance of the Bees«. The Roberta material gives general information on the theme and suggests experiments. An example for the theme »Dance of the Bees« is to understand and subsequently model the behavior of the bees in different situations. A first experiment suggested is to build a robot that implements a bee dance for nectar collection. The next step is to develop a robot bee that implements a behavior to guard the beehive. The Roberta didactic material delivers ideas to develop further experiments for a given theme. The course participants are encouraged to develop and realize their own

ideas using the knowledge they gained from the simple and compound tasks and the Roberta experiments suggested in the material.

Roberta themes and experiments concentrate in particular on nature and biology. Other examples presented in the Roberta material are Gaits (two legged, six legged), Maze and Ants (construction of an ant, ant trail). These themes are definitely more appealing and attractive for girls than for example soccer robots or fast driving vehicles.

An important concept of the organization and structure of the didactic material is a clear-cut separation of the experiments from their concrete implementation using a specific robot construction kit. The didactic approach is deliberately independent of a concrete robotic product. It can be adapted to new construction kits appearing on the market. A suitable robot construction kit has of course to provide functionality like actuators, sensors, programmable control and robot communication. At present, Roberta tasks and experiments have been adopted to the LEGO Mindstorms construction kits RCX and NXT and their programming environments. Some experiences with a robotics product of Fischertechnik have been made by one of our Roberta Regional Centres.

### III. ROBERTA TEACHER TRAINING

To ensure the quality of the Roberta concept, Roberta courses may only be delivered by certified Roberta teachers. As prerequisite Roberta teacher candidates have a didactical and preferably technical background. They have to pass a two days training delivered by Roberta coaches. The Roberta teacher training gives a hands-on introduction to the robots, the didactic material and the course concept. Special emphasis is on gender-oriented course design of mono-educative and mixed courses as well as on the creation of an open research-oriented learning environment. A certified Roberta teacher gets a login to the Roberta portal [1]. It provides the technical infrastructure to get access to additional didactic material and is the platform to get in contact with other Roberta teachers.

Fraunhofer IAIS trains and approves Roberta coaches who in turn train and certify Roberta teachers. All Roberta coaches have many years of experience as Roberta teacher. Furthermore they have outstanding expertise in didactic and educational robotics activities at universities or schools. Many of them are very active in coaching of robotic teams participating in robot competitions. Quality assurance, feedback analysis and continuous improvement of the teacher training is one of the key elements in the development strategy of the Roberta Initiative.

### IV. ROBERTA REGIONAL CENTRES

The Roberta Regional Centres coordinate the courses in their regions and support the Roberta teacher associated to them. Furthermore, upon demand, they lend out construction kits to their Roberta teachers. For each newly founded Roberta Regional Centre there is a certain number of Roberta teachers being trained and certified by Roberta coaches.

At present, 23 Regional Centres have been established in Germany. Usually, they are hosted at universities active in robotics and/or teacher education. During the project Roberta-Goes-EU, 12 Roberta Regional Centres have been established in Austria, Italy, Sweden, Switzerland and the UK.

### V. RESULTS AND EVALUATIONS

We outline some figures to be suggestive of the current status of the Roberta Initiative.

- Several hundred teachers have been trained to be certified Roberta teachers in Germany and Europe.
- Several thousands children participated in Roberta courses. In 2009, at least 5000 children (60 % girls) participated in registered Roberta courses in Germany.
- Roberta courses are often the entry for girls to set-up robotic teams that participate - successfully - in robot competitions, like RoboCupJunior or FIRST Lego League.

Part of the didactic material and the training concept was evaluated by the University of Bremen [2,3] during the funded projects 'Roberta' and 'Roberta-Goes-EU' by getting feedback from several hundreds of the Roberta course participants within an age range between 10 and 16 years. The analysis of the feed-back showed very similar results for Germany and Europe. In general, participation in a Roberta course significantly improves the self-confidence of girls in their own technical skills. This positive effect is slightly better if no boys are attending the same course. Nevertheless, the evaluation shows that boys are not distracted by the material, even though it was originally designed for girls. Based on these evaluations, Roberta courses are also open for boys. It is up to the Roberta teacher to decide this for a particular Roberta course. We asked the participants on their future interest in courses and got the following figures, again similar in Germany and Europe:

- 94 % enjoyed the courses
- 88 % would recommend it to friends
- 74 % would attend further courses

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### REFERENCES

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