The Didactical Potential of Robotics for Education with Digital Media

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ABSTRACT

The project “Roberta – girls conquer robotics” was launched by the Fraunhofer Institute (AIS) with the aim to help promote girls’ interest in sciences, mathematics and technology. As a summary of this research program, this article presents substantial results from the scientific evaluation of Roberta and suggests a new pedagogical approach towards the use of robotics in education. We discuss how didactics and technology (LegoMindstorms) interact in Roberta courses and how the materiality of robotics itself plays an important role here; that is, it already comes along as gendered material. Due to that, we draw conclusions towards general educational concepts for digital media. If carefully used as a didactical actor, robotics not only suits boys’ and girls’ interest in technological messiness but enables them for a technological-mediated life instead of just feeling overwhelmed. Robotics, therefore, can function as an appropriate medium for general education in the more comprehensive sense of developing personality and agency.

Keywords: cyber schools; distance learning; online learning; special education; strategies

INTRODUCTION

“Roberta — girls conquer robotics,” a project funded by the German Federal Ministry of Education and Sciences (BMBF), was launched by the AIS with the aim to help promote girls’ interest in sciences, mathematics and technology, and especially to encourage girls’ curiosity for engineering and computer science (Müllerburg, Petersen, & Theidig, 2004). Scientifically escorted by the University of Bremen, Digitale Media in Education (DiMeB) and the Institute for Didactics of Natural Sciences (IDN), Roberta addresses 10- to 16-year-old girls. The project’s basic assumption is that robot construction kits — offering possibilities to develop more self-confidence in one’s skills — provide an attractive access to technology for girls. This article
presents substantial results from the qualitative evaluation of Roberta courses and suggests a new pedagogical approach towards the use of robotics in education.

Background: Evaluation of the Roberta Project

The robot construction kits (Lego Mindstorm) consist of complementary mechanical, dynamic and electronic parts that allow the construction and programming of different types of robots. Basic models can be equipped with different engines and sensors (contact sensors and optical sensors). The programming can be done in two programming languages (RIS and NQC), the first offering easy-to-combine graphical blocks, the second requiring more teaching and explanation. The programs are transmitted on to the RCX module, a programmable Lego-brick with three input sockets for sensors and three for engines. To learn about informatics, the teaching of basic programming skills marks an important aim of the Roberta courses.

While informatics is treated in Roberta as a constructivist science, the educational sciences provide the necessary orientation for both shaping and evaluating digital learning environments. Our evaluation, thus, focused on the following questions:

- How can the interest in technology of girls and women be triggered by the use of robotics?
- How is curiosity for technology generated?
- How should learning environments be designed to satisfy both girls and boys?
- Which didactical concept is appropriate in connection with robotics?
- Are robotics and didactics suitable to influence the self-concept of the students?

Results of the quantitative evaluation show that the course experience in longer Roberta courses are noticeably stronger influenced by the focus of the teacher (didactics, informatics, gender, technology) than in shorter ones (Rethfeld & Schecker, 2005). The didactical focus stages as the most positive influence on the experiences of the participants – which is why the importance of the course-concept increases with the length of the courses. Although the self-concept of informatics and occupational orientation are only affected in medium-size and longer courses, all Roberta courses help to develop a more positive attitude towards informatics with the participants — both concerning the self-estimation of their own competence and their occupational orientation (Hartmann, Schecker, & Rethfeld, 2005). The following qualitative exploration allows for a deeper and more detailed insight into these issues. Methodically, material and video analysis, participative observation, as well as single and group interviews and expert interviews, were combined (Wiesner, 2004).

De/Construction of Gendered Materials — “Now we add real Formula 1 decorations to it”

Not only does the importance of didactics increase with the length of a Roberta course, the materiality of robotics itself plays an important role. Right from the start the material speaks for itself, because the children handle something they already know. The programmable bricks, engines and sensors, however, provide an unknown means to make experiences, so that children of both sexes are usually confronted with something new, too. The Legomaterial in this sense is evocative; that is, it generates presumptions, experiences and actions by itself. Treated from a gender-sensitive perspective, it even appears to be “gendered material”. A practical example:

The use of a car-like basic model often leads to car-like robots. Triggered by the impulse car-likeliness, boys — and often girls too — in no time construct vehicles. This phase of construction is often introduced by remarks such as: “Now we add real Formula 1 decorations to it.”

Were no (car-like) models given, girls and boys often construct models with strong analogies to humans and animals. If children
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