Smart Fashion and Learning about Digital Culture

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In this paper we summarize our results of analysing different construction materials and programming languages in robotic workshops and present a solution how to enhance the "Handy Crickets" technology to be used for a different application domain namely smart fashion. Smart fashion proved to be a topic equally attractive for girls and boys. We describe our experiments in workshops with children and their parents where we used the combination of smart fashion and robotic materials with software that is designed to allow free programming in very different application domains.

Keywords robotics; smart textiles; wearables; gender; computer and education

1. Introduction

ICTs in educational context are often seen as multimedia facilitators for traditional learning on the one hand or as tools students must be able to use in order to be well educated for workplaces. In our transdisciplinary research group Digital Media in Education (DiMeB), where researchers from different backgrounds as computer scientists, pedagogists and sociologists work together, we see digital media and their core, the computing unit, as special material that should be used and designed to help understanding the emerging "digital culture" that encompasses societal and economical changes like "information society" as well as changes in the habitus of everyday life.

Following this goal we develop concepts for workshops with a most diverse target group of children, young people and adults from various social backgrounds. In those workshops we use the imagination of the participants as an individual access to the technologies and their concepts. We use design as a method for deepening the understanding of those concepts and to enable the participants to develop ideas how to use the technologies for their own purposes. The technologies themselves enable the participants to understand abstract concepts trough concrete access.

In our workshops for children in the age of 9 to 14 at schools as well as in spare time we started working with Lego Mindstorms technology and the provided graphical programming environment Robotics Invention System (RIS) for constructing and programming robots. Meanwhile we prefer Crickets and we use smart textiles as material in different contexts as well as a text-based programming environment that was developed at our research group to support children in their self-determined access to technology.

Originally the programmable bricks -the underlying technology for robotics- were invented to support children in building a wide range of different applications including "autonomous creatures" but also biofeedback systems or musical instruments [1]. In our experiences and research on using robotics in workshops with children we observed the influence of the physical material as well as software on children's imagination. The topic "robotics" is much more appealing to boys then to girls and the design of the robotics material can restrict the children in their ideas to build projects different from wheeled car-like robots. In some software widely used for educational robotics the metaphors fit only for those robots on wheels.

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2. Research carried out on Robotics

In the research group Digital Media in Education we are organizing and evaluating computing workshops for children, young people and adults in scholarly and informal learning settings. We design new and improve existing materials to be used in those workshops. As results of the evaluation we can point out the following conclusions.

2.1 Girls and Robotics

The project Roberta was using robotics to raise interest in technologies by girls and organized more than 153 workshops with 1,880 students, 1,600 of them were female. To develop gender-sensitive materials as well as didactic concepts the workshops were evaluated with quantitative and qualitative methods including observation, video-analysis and group interviews. Our research group accomplished the qualitative part of the evaluation.

The project worked with the commercial system Lego Mindstorms and different programming languages mostly RIS, NQC and Robolab. As results important for further development we like to point out some findings on the effects of robotics materials. These effects are closely connected to the educational setting and didactic concepts. The material as “evocative material” [2] itself influences the imagination of children as it raises associations. From a gender perspective it can also support gender-stereotypical behaviour, therefore material can act as “gendered material” [3]. For example the boys in some workshops came up with car-like models in the end no matter what their initial idea looked like and dominated the classroom with their ideas [4].

2.2 Comparison of evocative materials

Taking up the results of Roberta we compared different technologies that provide certain degrees of openness and freedom to find out how to design material that supports children in creating a wide range of ideas and allow them to succeed in building them. Using the Handy Cricket system instead of Lego Mindstorms we observed a difference in how children could realize their ideas with the technology [5]. When using Handy Crickets in combination with tinkering materials most children came up with projects in the end that looked very similar to the sketches of their initial ideas. Open materials seem to allow children to work on their ideas without being narrowed by the material or as Resnick and Silvermann[6] put it as a recommendation for designing construction kits: provide “LOW FLOOR AND WIDE WALLS” meaning low requirements to get into the technology but the possibility to use the material on advanced level for a lot different domains.

2. Programming Environments

The experiences with the Robotics Invention System showed that one of the most restricting drawbacks is that especially younger children without previous knowledge in programming could not find access to the programming independently. They found no support through the graphical interface to develop ideas how to start exploring the possibilities of programming.

Therefore, we made a programming environment that was meant to support especially the self-determined access of children. We decided to use text-based programming because in a comparison between text-based and graphical-based programming the children seemed to be much more consciously engaged in the process of constructing the source code when working with text. We based the programming environment on the existing open source project Jackal which provided the possibility to program the Handy Cricket with Cricket Logo already supported through syntax-highlighting. We extended the environment with visual and textual explanations to every command of the Logo language and translated the commands into German language. Furthermore, we let children develop categories to structure all the commands in areas that have meaning to them.

Current Developments in Technology-Assisted Education (2006) 3

The experiences showed the success of our approaches in that especially children were more able to explore the programming independently from the support of the tutors. However, Robologo still focuses on robotics especially through the categories and names of commands that uses metaphors suitable for robots.

2.4 Problems

To summarize: the material both physical and virtual strongly influences the children in robotics workshops. It can narrow their ideas and support gender-stereotypical behaviour and lead to learning environments dominated by boys' ideas of robotics, unattractive to girls.

3. Combining Smart Textiles and Robotics

The emerging field of Smart Textiles and Wearable Computing changes the ways how we interact with technology in our "digital culture". Early research in the field took place in the military domain for example to provide better camouflage for soldiers and in health monitoring. Designers and artists use Smart Textiles and Wearables for fashion and life-style products. Fashion items react to their environment and the wearer. Berzowska thinks of this new role of fashion: „One application of reactive fashion is to enable the idea of changing our skin, our identity, and our cultural context.“ [7]. In our understanding of education in times of the „digital culture“ these changes should be transparent and understandable to children who are surrounded by new smart objects.
Though there is a huge potential of Smart Textiles for education as a soft medium to raise technology interest as discussed by Berglin [8] and Eisenberg [9] there are only few applications in the educational domain. A work by Berglin – the *spookies* - uses textile materials for computational toys that allow creative use and communication [8]. Buechley et al. [10] developed a textile based construction kit children can use to build their own smart fashion clothes and accessories. This approach is especially appealing to girls. We try to combine robotics with Smart Textiles to enable the children to build a wide range of applications of fashion items as well as motor-powered robots in a quick and prototypical way.

3.1 Hardware

The Handy Cricket is a small, inexpensive programmable device providing sensor inputs and actuator outputs. It is used for robotics in and out of classroom as well as for scientific experiments at school [11] and works with different kinds of sensors and actuators available in electronic stores. We use the device as controller for textile applications the children built. As textile sensors soft pushbuttons made of two layers of conductive fabric, textile stretch sensors that consist of woven conductive yarn and regular analogue and digital sensors work with the Handy Cricket. As the children build wearable applications tilt sensors and temperature sensors are very popular because they can be used to recognize gestures and biometric data on a very basic level. As textile actuators we use thermo-chrome textile colour in combination with resistance wire to heat the fabric up and make for example letters appear. Other "hard" actuators often used in children's textile projects are LEDs and voice recorders that can playback sounds the children recorded before. As interface between textile materials and electronic material we mainly used snaps soldered onto cables where children could sew conductive thread to.

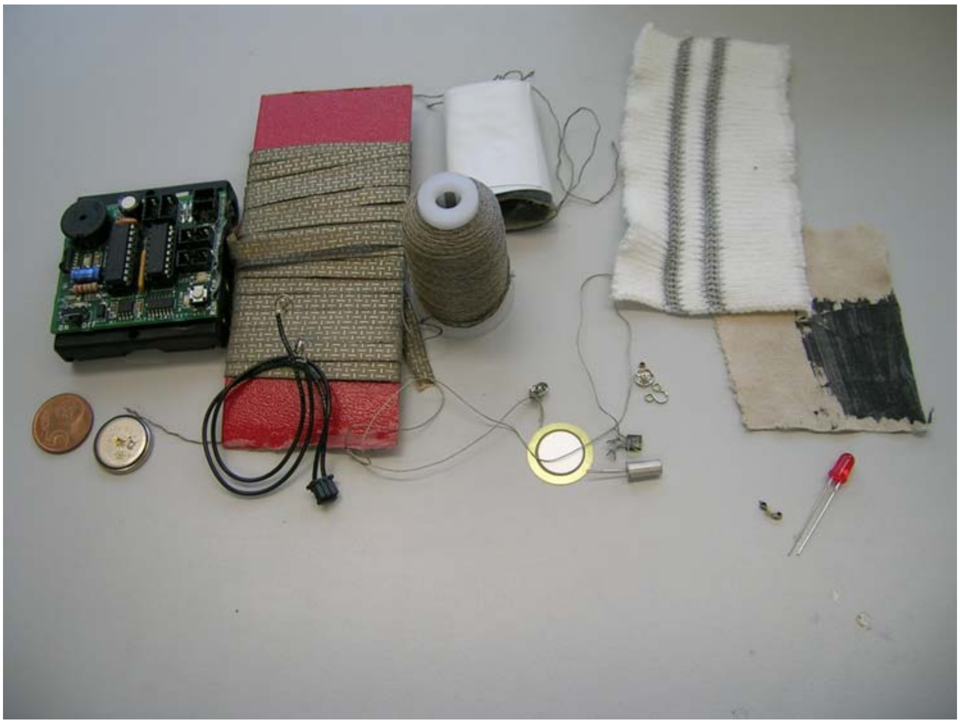

Figure 1: From left to right Handy Cricket, power supply, connectors, yarn, sensors, actuators

3.2 Software adaptation

Originally developed for robotics the software “Robologo” uses metaphors fitting in the context of robotics. A category name like “Movements” is understandable for children who build mobile robots. To open the software for a wider range of applications including Smart Textiles we decided not to simply rename categories in names better suited to the new domain of Textiles but we integrated *Social Tagging* in the Graphical User Interface. Children can add keywords to the different categories and commands to make it easier to remember what the commands stand for and support other children to make out the right commands.

3.3 First results of testing in the field

Children, young people and adults worked together using the described system in workshops with different durations. Using the Crickets and Robologo allowed the participants to build quick prototypes in only a couple of hours.

Every workshop starts with collecting imaginations of the participants towards a specified topic related to the used technologies, an introduction into the used materials and an introduction into the programming environment. The participants develop a project idea they want to realize in the workshop, are provided with the needed materials and work independently in small groups supported through tutors. Two examples shall be explained here to clarify how the combination from Handy Crickets and Robologo were used to realize individual project ideas. One boy and his mother planned to create a foul-sensitive tricot for soccer games. They used a stretch sensor that was recognised when someone pulled hard at the players tricot. The Handy Cricket was programmed to activate a voice recorder when a

Current Developments in Technology-Assisted Education (2006) 5

specified value of the stretch sensor was overstepped. In this case the voice recorder called out “foul” loudly.
A girl came up with the idea of an apron that should support her in the frightening dark cellar of her home. It recognised fading light through a light sensor and lighted several LEDs automatically. When the apron detected rising light again, the LEDs went out one after another with short time intervals in between for better effect. Both projects demonstrated the successful process of creating an idea, finding suitable materials and programming commands and construct the final product very near to the original idea. At the end of the workshops the participants present their works in front of an audience. They take pride in their work and are highly motivated to explain the design process.

4. Conclusions and future work

Our first workshops have shown that Smart Textile Material is appealing both to girls and boys and in combination with a system like the Handy Cricket and Robologo makes programming easy to learn and the concepts behind the technologies easy to explore and understand. The process from the project idea, over the construction and programming to the final product is shorter compared to robotic workshops where movable creatures were built but contains nevertheless all vital elements necessary to gain deep understanding. The imaginations towards smart textiles are less concrete than towards robotics especially regarding children's imaginations. This leaves more room for creativity and individual projects but also demands for a didactical framework that allows children to develop imaginations towards this new material.

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