Chapter 105
Programming Robots in Kindergarten to Express Identity:
An Ethnographic Analysis

Marina Umaschi Bers
Tufts University, USA

Alyssa B. Ettinger
Tufts University, USA

ABSTRACT

This chapter presents a research program that uses robotics as a powerful tool to engage Kindergarten children in developing computational thinking and learning about the engineering design process. Using an ethnographic analysis of an experience in a Kindergarten classroom at the Jewish Community Day School (JCDS), a pluralistic school in Watertown, MA, in which children worked with robotics as a way to explore issues of identity, the chapter highlights both developmental and technological considerations that need to be addressed when engaging young children with robotic activities. This project used an innovative hybrid tangible programming system composed of interlocking wooden blocks, called CHERP, specifically designed to meet the developmental needs of young children. While many robotic programs highlight building aspects and their relationship to engineering education, the approach presented in this chapter complements this by focusing on programming by teaching powerful ideas from computer science at a very early age.

DOI: 10.4018/978-1-4666-1945-6.ch105

INTRODUCTION

Typically, “robotics” brings to mind metallic human-like contraptions wired with complex electronics. However, this chapter describes an experience in which simple Lego-based robotic cars were programmed by Kindergarten children with smart wooden blocks using CHERP (Creative Hybrid Environment for Robotic Programming), a developmentally appropriate tangible language (Horn, Crouser & Bers, 2011). This work was inspired by the realization that in the early grades, children learn very little about engineering and technology. Just as it is important to begin science instruction in the early years by building on children’s curiosity about the natural world, it is as important to begin engineering instruction and the development of technological literacy by building on children’s natural inclination to design and build things, and to take things apart to see how they work (Bers, 2008; Petroski, 2003). Robotics is a wonderful platform that taps into what is unique to today’s human-made world: the fusion of electronics with mechanical structures.

With the growing popularity of robotics, the use of educational robotic kits and programming languages for controlling the robot’s behaviors is becoming widespread in high schools, middle and elementary schools (Rogers, Wendell & Foster, 2010). In order to bring robots to “life” children must create computer programs—digital artifacts that allow robots to move, blink, sing, and respond to their environment. Previous research has shown that children as young as four years old can understand the basic concepts of computer programming and can build and program simple robotics projects (Bers, 2008; Cejka, Rogers, & Portsmore, 2006; Bers et al, 2006; Bers & Horn, 2010; Kazakoff & Bers, 2010; Bers, 2010a). However, young children need to work with interfaces that are developmentally appropriate. The robotics-based programming language we used, called CHERP, is such a tool and was developed by Bers and her DevTech research team at Tufts University (Horn et al., 2011). Rather than writing computer programs with a keyboard or mouse, the CHERP system allows children to instead *construct* physical computer programs by connecting interlocking wooden blocks. CHERP is described in the following section.

This chapter takes an ethnographic approach to analyze and describe the learning experience of 23 Kindergarten students who participated in a month long robotics curriculum called TangibleK, developed by the DevTech research group at Tufts University with funding from the National Science Foundation. The TangibleK curriculum, which utilizes CHERP to teach robotics and computer programming concepts to Kindergarten students, was adapted and extended to explore issues of identity at the pluralistic Jewish Community Day School (JCDS) in Watertown, MA. While the TangibleK curriculum encourages cognitive development in such areas as logical and sequential thinking (Kazakoff & Bers, 2010), the overarching project goal at JCDS was not only to engage children in learning about robotics, but also to provide them with robotics as a different medium, to express their explorations of identity in a creative way.

We collaborated with JCDS Kindergarten teachers to incorporate the TangibleK curriculum into the class’ end-of-year project that encouraged the students’ reflection of their accomplishments during the school year and their developing sense of self. This culminating project was called *Mi Ani* (“Who am I,” in Hebrew). The extension to the TangibleK curriculum for the *Mi Ani* project focused on the creation of robotic artifacts and programmed behaviors to express the kindergartners’ individual Jewish identities. Because the medium of robotics allows the display of actions, as opposed to static facts, children chose to create robots enacting behaviors that are related to their different ways of being Jewish. For example, one student programmed his robot to spin to represent lighting the Hanukkah menorah, while another programmed hers to roll back and forth, mimicking rolling out dough for Passover matzah. The