Chapter 29
Robotics Community Experiences:
Leveraging Informal Design and Learning Experiences to Motivate Urban Youth in STEM

Kimberley Gomez
UCLA, USA

Emily Hamner
Carnegie Mellon University, USA

Debra Bernstein
TERC, USA

Ung-Sang Lee
UCLA, USA

Jolene Zywica
Opportunity Education Foundation, USA

Jahneille Cunningham
UCLA, USA

ABSTRACT

In this chapter, the authors focus on the motivational and engagement aspects of robotics technical design experiences for youth participating in two different afterschool robotics programs: the Digital Youth Network (DYN) and Robot Diaries (RD). The programs each take a different approach to motivating and engaging participants with robotic technology and design. The authors analytically describe and compare the relationship between programmatic goals of each program and participant experiences. Programmatic goals influenced the participants' opportunities to engage with technology, increased their comfort level with technology, and helped them develop skills in adapting technology to facilitate individual and group-centered design goals. The authors offer recommendations for the design of robotics programs for youth and point to the importance of the role of audience and materials selection that engage and motivate youth, instructor roles, and instructor knowledge.

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INTRODUCTION

Full and active participation in our society requires today's youth to be technologically and scientifically literate. Out-of-school activities, such as after-school robotics clubs and workshops, potentially provide an opportunity for youth to develop some of these necessary skills. Recent reports suggest that, unlike during the middle of the previous decade, when computer science enrollments at the university level were dropping (Vegso, 2005), computer science program enrollment has been improving (Zweben, 2011). With this in mind it seems critical to provide an opportunity for positive engagement in technology design to maintain this trend. However, even for those who for a variety of reasons choose not to enter a STEM career field, we suggest that participating in a robotics design experience can provide a set of knowledge and skills fundamental to the development of technological literacy (ITEA, 2000), including increasing the comfort level and use of technology as well as learning to adapt technology to facilitate goals.

This chapter will focus on youths' opportunities to engage in design through participation in two different robotics programs. Through an analytic comparison of these two programs, we offer insights on key features of robotics programs and how these features can support various programmatic goals, structures, and student opportunities.

Existing robotics programs differ on a number of dimensions, including venue, scope, duration, and pedagogical approach. While some programs focus on the acquisition of STEM knowledge and skills (e.g., Miller & Stein, 2000; Verner, Waks, & Kolberg, 1999), others facilitate more artistic goals such as personal or creative expression (e.g., Montemayor, Druin, & Hendler, 2000). The two programs considered in this chapter, the Digital Youth Network (DYN) and Robot Diaries (RD) each take a different approach to motivating and engaging participants with robotic technology and design. Both programs aim to provide young people with hands-on opportunities around robotic design, but they differ on a number of dimensions. The DYN uses the goal of a robotics competition to deeply engage participants in teamwork focused on engineering and programming challenges, while RD combines arts and engineering objectives, allowing participants to build individual, expressive robots that they then showcase for family and community members. Both programming contexts take seriously the notion that young, traditionally educationally underserved participants can, and should, have opportunities to learn about design and development within a supportive, mentored experience.

LITERATURE REVIEW

Much has been written about the power of robotics training experiences to increase young people's exposure to science, technology, and mathematics and to increase conceptual knowledge (Hamner, Lauwers, Bernstein, et al., 2008; Resnick, Berg, & Eisenberg, 2000; Turback & Berg, 2002). The literature suggests that young people enjoy robotics activities and competitions, enjoy the collaboration with others, and become deeply engaged in design experiences (Bernstein, 2010; Morrison, 2006). What we offer in this chapter is an exploration of the value of robotics through a brief consideration of two examples of robotics experiences, both in informal contexts, but with different overarching aims – a team-based, robotics competition and a community-centered, robot building workshop. Our aim is to characterize these experiences and, through examining particular elements of the programs and drawing comparisons across the two, consider how, and why, robotics programs in K-12 settings can build habits of mind (educational as well as social) that are valued in formal as well as in informal learning contexts.