Chapter 3
Promoting Diversity and Public School Success in Robotics Competitions

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ABSTRACT

The objective of robotics competitions, such as FIRST LEGO® League (FLL®), is to create a tournament that promotes high-level engineering and academic engagement in students by providing the most rewarding experience possible for the largest group of students. To increase the number of students age 9-14 successfully participating in FLL® from public schools, and to concurrently increase the diversity of the pool of student participants, the Georgia FLL® organizers have implemented a number of interventions. These interventions can be grouped into A) Centralized policy decisions that impact how the program is run at the state level; B) Outreach activities that provide low-income teams with training and supplies; C) Promotion of LEGO® Mindstorm use within the actual school curriculum; and D) Partnerships with school systems to promote after-school FLL® robotics clubs. This chapter reviews these efforts and their effect on tournament diversity.

INTRODUCTION

There is substantial concern, both at the state and national level, that student interest in science, technology, engineering and math (STEM) fields is not adequate to meet the future competitive needs of the United States (National Academy of Sciences, 2010; Augustine, 2007). As a result, different strategies need to be implemented and evaluated to determine their effectiveness in fostering the type of student success that will help sustain an early interest in the STEM disciplines. Many studies have shown, at

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least anecdotally, that robotics activities and competitions such as FIRST LEGO® League (FLL®) can successfully promote K-12 student engagement in, and mastery of, engineering skills and habits of mind (Barker & Ansorge, 2007; Berger, Jones & Knott, 2005; Brown et al., 2006; Klenk, Ybarra & Dalton, 2004; Melchior, Cohen, Cutter & Leavitt, 2005; Ohland, 2006; Petre & Price, 2004; Sloan-Schroeder & Ingman, 2005; Wang, LaCombe & Rogers, 2004; Weinberg, Pettibone, Thomas, Stephen & Stein, 2007; Williams, Ma, Prejean, & Ford, 2007). Generally the benefits of these types of activities are limited primarily to students who self-select into after-school robotics clubs or summer programs or who live in neighborhoods where parents have the time, resources and knowledge to successfully coordinate and coach a FLL® team. Without intervention, these common pathways to participation too often rule out active involvement by low-income students in many predominantly minority schools. These students are the ones most in need of experiences such as FLL® to help them maintain their engagement in STEM and counter the low achievement reported on national assessments (NAEP Report, 2009).

Typically, in FLL® competitions the majority of teams that emerge successful from the qualifying tournaments are independent (home-school or neighborhood) teams, and virtually all of the state-level awards go to those types of teams, rather than to teams originating in public schools. This chapter details efforts taken by the authors, as part of Georgia Tech's Center for Education Integrating Science, Mathematics and Computing (CEISMC) and the primary Georgia FIRST LEGO® League organizers, to increase the diversity of the FLL® tournament by increasing the number of under-represented minority children from public schools who successfully participate in the event.

BACKGROUND

The FLL® competition is frequently promoted as an effective method of introducing middle school children to engineering problem solving and of increasing the pipeline of students into engineering and other STEM disciplines. The FLL® program centers on a Challenge that is released by the national FIRST organization annually in early September. Participating students in grades 4-8 (ages 9-14) tackle a problem with a socially relevant theme that is designed to increase the students' awareness of current affairs. Each student team can have up to ten students and is required to build a robot using the LEGO® Mindstorm robot set and program it to perform 8-10 tasks that relate to the overarching theme. Teams are also required to research the theme and develop a product or strategy to address the social issue.

FLL® tournaments, generally held in late November through January, consist of a 3-round robot competition, presentation and judging of the research projects, judging of the technical and creative merits of the robot designs, and an analysis of the quality of the teamwork and cooperation between team members. During each round of the robot competition every team competes head-to-head against another team, attempting to complete as many tasks as possible in 2.5 minutes. The robots must begin at a home base and may only be manipulated when the robot returns to base. During the robot's autonomous navigation of the challenge field, teams earn points for each task the robot completes. All teams have a minimum of three chances to run their robot during each tournament. In the last four years, FLL® has addressed issues such as: Biomedical engineering (2010); Smart roads and traffic engineering (2009); Climate connections (2008); and Alternative power sources and use of resources (2007).

The State of Georgia has a highly successful state FLL® tournament series that has grown in size from 48 teams in 2004 to 297 teams in 2010, and it currently serves approximately 2,000 students annually (Figure 1). In 2010 the Georgia FLL® tournament series consisted of twelve first-round qualifier

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