

## Executive Summary

### **Evaluation of the *FIRST* LEGO<sup>®</sup> League “Climate Connections” Season (2008-09)**

The *FIRST* LEGO<sup>®</sup> League (FLL) is an international robotics program in which teams of young people aged 9-14 assemble and compete robots (based on the LEGO Mindstorms kit) designed to accomplish tasks associated with a real-world “Challenge.” In 2008-2009, the Challenge theme was “Climate Connections,” focusing on issues related to the climate and the relationship between people and climate. Approximately 7800 teams participated in the *FIRST* LEGO<sup>®</sup> League in the United States and Canada with up to 10 young people per team, led by one or more adults (teachers, parents, or other adults). During the competition season, teams design, assemble and program a robot to perform a set of defined tasks related to a real-world issue that represents the theme for that year’s competition. Teams are also required to conduct a research-based Project related to the issue/theme for that year’s competition. The Challenge culminates in local, qualifying, and state/provincial tournaments in which teams present their Projects and compete their robots for a variety of awards. Reflecting the program’s goals of promoting both interest in science and technology and a sense of “gracious professionalism” (i.e. the ability to work cooperatively, even with competitors), the judging and awards at the tournaments include a focus on teamwork and cooperation, as well as on design and robot performance.

In 2003-04, the Center for Youth and Communities conducted an evaluation of the *FIRST* LEGO<sup>®</sup> League program with the goal of documenting the program’s impact on participating youth, adults, and institutions. The primary focus of that study (referred to in this report as the 2003 FLL study) was on assessing the degree to which participation in FLL had a positive impact on the knowledge, skills and interest in science and technology among participating youth; however, the study also examined the implementation of the program from the perspective of team leaders (i.e., perceived strengths and weaknesses) and its effectiveness in building and retaining the engagement and support of parents and other participating adults. That study drew upon several major sources for data – end-of-season surveys of participants, team leaders, and parents of participants from teams at eight of the FLL state tournaments; telephone interviews with approximately 30 team leaders, drawn from the same group; and site visits to five teams to talk further with FLL participants.<sup>1</sup>

For the 2008-09 season, *FIRST* asked Brandeis University to update the 2003 study, using comparable methodology and survey instruments, to provide an up-to-date assessment of the program’s implementation and impact. As before, three major questions guided the proposed evaluation:

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<sup>1</sup> Alan Melchior, Tracy Cutter, Faye Cohen, “Evaluation of the *FIRST* LEGO League.” Prepared by the Center for Youth and Communities, Heller School for Social Policy and Management, Brandeis University, July 2004. Available at: [http://www.usfirst.org/uploadedFiles/Who/Impact/Brandeis\\_Studies/2004%20FLL%20Report.pdf](http://www.usfirst.org/uploadedFiles/Who/Impact/Brandeis_Studies/2004%20FLL%20Report.pdf). The Center for Youth and Communities has conducted a number of studies of *FIRST* programs, including evaluations of the FLL and Jr. FLL programs, the *FIRST* Robotics Competition, and the *FIRST* Tech Challenge.

1. **What is the impact of the *FIRST* Lego League program on participating young people?** To what degree is the program meeting its goals of introducing young people to science and technology concepts; building key life, workplace and academic skills; inspiring interest in science and technology; and/or improving attitudes towards school and the relevance of education?
2. **What is the impact of the *FIRST* Lego League on participating adults and institutions?** To what extent is FLL successful in engaging and motivating team coaches? Are parents sufficiently satisfied with their experience with the program and its impact on their children? Are both parents and coaches motivated to continue their involvement over a longer term, and if not, what can the program do to support a longer-term commitment? Also, has participation in the program had an impact on the way in which teachers work with students or on the schools or community organization involved in the program?
3. **What are the strengths and weakness of the FLL program from the perspective of participating adults and youth and what steps, if any, could *FIRST* take to improve the program?** To what extent are teams completing the major elements of the FLL model? Are young people given the opportunity to play an active, leadership role on their teams? What kinds of barriers and challenges are identified by team leaders and what suggestions do team leaders and participants have for improving the FLL experience?

As in 2003-04, these questions provide an opportunity to assess the program's current impact on its participants and to identify ways in which the program could be strengthened as it continues to grow.

### **Methodology**

To address these questions, the Center for Youth and Communities replicated the core elements of the methodology used in the 2003 study, with some changes in an effort to reach the broadest sample of FLL teams and team leaders and to make the most effective use of limited evaluation resources. As such, the 2008-09 study (referred to as the 2008 study) drew on several major groups of data:

- The primary source of data for the study was a set of end-of-program surveys distributed to FLL team members, their parents, and team coaches in a national sample of approximately 440 teams in the U.S. and Canada. The goal of the survey process was to develop a comprehensive picture of FLL implementation and impacts from multiple perspectives (coaches, team members, and parents) from a nationally representative sample of teams. 188 teams returned survey packets, yielding a total of 986 team member surveys, 118 coach surveys, and 817 parent surveys. The 43% return rate and overall sample size is comparable to that for the earlier 2003 study.<sup>2</sup>

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<sup>2</sup> The response rate for the 2003 study was 47% (185 teams), yielding 919 student surveys, 162 coach surveys, and 699 parent surveys.

- The study also supplemented the surveys from the sample teams by conducting an additional, online survey of FLL team coaches nationally (across all teams) in order to gain a picture of program implementation and impacts from a broader group of teams. The survey link was sent to approximately 6800 FLL team coaches, generating a total of 574 responses (a response rate of approximately 8%).
- Finally, evaluation staff also conducted informal interviews with team leaders, team members, and parents at a small number of tournaments. The tournament interviews provided an opportunity to supplement the survey data with richer, more open-ended feedback from additional youth and adults.

### Summary of Key Findings

The results from the 2008-09 study largely mirror those from the 2003 study, supporting the conclusion that FLL continues to involve young people in an engaging learning experience and to generate strong, positive outcomes for participating youth and adults.

- As in 2003-04, the large majority of young people report actively participating in a wide range of FLL activities, and doing so in a supportive environment, resulting in increased interest in science and technology, a better understanding of the role of science and technology in solving everyday problems, increased interest in school, improved life and workplace-related skills, and a more positive outlook on themselves and their future. Most anticipate continuing with *FIRST* into high school.
- Team leaders also report positive impacts on team member attitudes and skills, on their own knowledge of science and technology, their appreciation of what young people can accomplish, and on the visibility and reputation of their organizations in the community.
- Finally, parents also report a positive impact on their children from participation in FLL, confirming that the program has helped to increase young people's interest and engagement in science and technology, their social skills, and their sense of self-confidence .

While the surveys do highlight several areas of the program needing improvement, the primary message from study is that the program is continuing to provide a high quality and effective experience for participating youth.

Key findings include the following:

#### *Team, Coach and Participant Characteristics*

- **Based on the participant, coach, and parent surveys, in 2008-09 the “typical” *FIRST* LEGO League team looked very much like the teams in 2003-04.** The average team included approximately eight young people ranging in age from 9 through 14, led by an FLL coach (most commonly someone with a teaching background) and assisted by an average of three other adults.
  - Teams varied in the age ranges of their team members, with 45% of the teams serving younger participants (Grades 4-6), 23% serving older participants (grades 7-9) and 32% of teams serving students from the full age range in the program. The fact that one-third of

FLL teams cross age groups means that the suggestion often made to divide older and young teams into separate competition “tiers” may be difficult to implement.

- Despite an effort to increase the involvement of girls, the large majority of FLL participants were boys (approximately 70%) with the average team reporting between five and six boys and two to three girls.
  - As in 2003, most participants in 2008 were White (66%), though the proportion of non-White participants had increased substantially since 2003, in part through a substantial increase in the proportions of Asian youth involved in the program.
  - Most young people had joined FLL (according to their parents) because of a prior interest in science and technology, though many also joined because they enjoyed playing with LEGOs or were encouraged to join by an adult.
- **While the FLL participants looked similar to those of five years earlier, the characteristics of the FLL coaches, particularly those in the evaluation’s sample sites, have changed since 2003.** The large majority of coaches are White (88%); however, the ‘typical’ FLL coach is now more likely to be female than male (56% female in 2008 vs. 32% in 2003), less likely to bring a background in science and technology, and somewhat more likely to bring a background in teaching. The average FLL coach had more than two years of prior experience in the program, but roughly 40% of the coaches were “rookies,” a figure comparable to that in 2003. The growing percentage of coaches without a technical background and the relatively high percentage of first-time coaches highlights the continuing need to provide access to advice and technical support for FLL coaches.
  - **Most FLL coaches are familiar with *FIRST*’s other programs, but less than half the FLL team members and parents in the study were familiar with FTC or FRC, suggesting a need to strengthen the connections between programs.** Among the FLL coaches, there is a relatively high degree of familiarity with other *FIRST* programs: 70% or more report being familiar with FRC, FTC, and Jr. FLL. However, among FLL participants and their parents, awareness of *FIRST*’s other programs was less common. Less than half of the parents and 40% of team members in the study said they were familiar with FRC, and 33% of parents and 26% of team members were familiar with FTC. When participants were familiar with *FIRST*’s other programs, they were interested in participating: among participants familiar with FTC and FRC, 80% were interested in continuing their involvement in *FIRST* when they are older.

#### *The FLL Program Experience*

- **The 2008 participant surveys indicate that FLL is continuing to provide an engaging, high quality hands-on experience for both boys and girls in the program, and that the large majority of participants are satisfied with their experience in FLL.**
  - Most team members (generally more than 80%) reported participating in the full range of FLL tasks, including designing, building, and programming the robot, working on the Project, and playing an active role at the tournaments. Most (77%) also reported having an opportunity to work with an adult with technical expertise (a team leader or technical

mentor). Almost all (93%) attended at least one tournament, and most (86% or more) rated their tournament experience positively.

- Most teams (roughly 95%) also worked on the Project, according to the coach surveys, and spent more than one-third of their time on that activity. Most coaches (nearly 90%) thought that the Project was an important part of FLL and that the real-world focus of the project made it more fun and exciting for team members.
- Data from the team member surveys also point to a high quality program experience, with most participants (90% or more) reporting that they made important decisions on their team; had important responsibilities; felt they belonged and were an important part of their team; got the attention they needed from adults, felt safe; and had fun working on their team – all indicators of high quality youth development experiences.
- More than 75% of all FLL participants and 88% of age-eligible participants indicated that they planned to return in 2009. (Most of those not expecting to come back indicated that they would be too old or would not have enough time.) Ninety-five percent (95%) of team members rated their experience as “Good” (35%) or “Excellent” (60%).
- As in 2003, there were differences in the patterns of participation in FLL activities among girls and boys, with boys more likely than girls to report involvement in the planning, building, programming and testing of the robot, while girls were more likely to report involvement in the Project and team support activities (fundraising, creating materials, etc.). However, both boys and girls rated their program experiences positively and were equally likely to indicate an interest in continuing in FLL.

### *Impacts on Participants*

- **As in 2003, the data from the 2008 coach, team member, and parent surveys indicate that FLL is having a positive impact on the interests, knowledge and skills of participating young people.** From all three perspectives, FLL was seen as increasing participants’ interest in science and technology, their understanding of the role of science in solving real-world problems, their engagement in school, and their teamwork, leadership, planning and management skills, among others. While parents were somewhat less likely to report gains on all measures (as was the case in 2003), high percentages of all three groups (coaches, team members, and parents) reported positive outcomes. Overall, the results for 2008 are remarkably similar to those in the 2003 study, providing additional validation to the findings.
- The large majority of FLL coaches in both the sample sites and the national “All Teams” survey reported positive impacts on their team members’ interests, attitudes, and skills. Roughly 90% reported that FLL had increased team members’ interest in or awareness of how math and science are used in the real world and interest in computers and technology; 80% reported an increased interest in science and technology careers, and 65%-70% reported increased interest in school success and college among team members. Most coaches (80% or more) reported an increased understanding of basic science principles among participants and gains in a variety of life and workplace skills, including problem-solving, teamwork, leadership, planning and time management skills. Coaches also reported gains in basic math skills (75%), writing skills (64%-68%), and basic computer programming skills (97%). In response to open-ended survey questions, coaches pointed

to increased enthusiasm for science and engineering, increased ability to work as a team, increased confidence, and growing awareness of the broader world (especially on climate issues) as notable outcomes for their teams.

- FLL participants also reported positive impacts on interests, knowledge, and skills. More than 85% of team members reported that, as a result of FLL, they wanted to learn more about science and technology (89%), computers and robotics (93%), and how science and technology could be used to solve real-world problems (88%); 77% reported that they were more interested in a job using science or technology, and 63% said they wanted to become engineers. Participants also reported being more academically motivated, with 89% more interested in doing well at school and 88% more interested in going to college. Over 90% of participants also reported a better understanding of the role of science and technology in solving everyday problems and increased insights into their own strengths. Most participants (over 90%) also reported gains in life and workplace-related skills including the ability to work with others on a team, find information, manage time, use trial and error to solve problems, and make presentations. Interestingly, a substantially higher percentage of team members also reported gains in writing skills (69%) than was the case in 2003 (51%), perhaps reflecting increased emphasis on the Project.
- As in 2003, parents also reported participant gains, though at somewhat lower rates than were reported by coaches and team members. More than half the parents surveyed reported that FLL increased their child's interest in how science and technology could solve real-world problems (84%) and their interest in computers and technology (83%); 67% reported increased interest in careers in science and technology. Smaller percentages (40% or more) reported that their children were more interested in school (44%) or in going to college (42%). Parents were substantially more likely to report gains in their children's knowledge, skills, and attitudes about themselves as a result of the program, including their child's ability to work on a team (81%), their ability to solve problems (81%), their sense of belonging (80%) and their sense that he or she can succeed with effort (80%). In response to open-ended survey questions, parents reiterated those results, indicating that, in addition to an increased interest in science and technology, their children had learned the value of teamwork and how to work with others, while gaining a sense of belonging and confidence in their own abilities.
- While both boys and girls showed positive impacts from their involvement in FLL, both participant and parent surveys indicated some differences between the program impacts on boys and girls, with boys more likely to report increased interest in computers and technology and technology-related careers and girls more likely to report increased interest in projects related to Climate Connections and in going to college. Boys and girls also differed in the patterns of skill gains they reported, with girls more likely to report gains on social skills (team work, solving disagreements) and communications skills, while boys were more likely to report gains in technology-related skills. These differences were also reflected in parent assessments of participant impacts.
- While there were some differences in impacts among boys and girls, there were few differences between older and younger participants, though younger participants (and their parents) were more likely to report an increased interest in the science associated with the Climate Connections project.

### *Coach and Parent Satisfaction and Impacts*

- **The data from the FLL coach and parent surveys also indicates that both coaches and parents are satisfied with their experience in FLL.**
  - Coaches saw FLL as an opportunity to interest young people in science and technology and pointed to the opportunity to work with young as the major benefit of their experience. Most rated the support they received and the materials provided by *FIRST* positively; and almost all (90%) reported that they were “Satisfied” or “Very Satisfied” with their experiences as coaches. Among those coaches who were teachers, most saw FLL as having a positive influence on their teaching, positively impacting their attitudes towards students. A majority of coaches also report that involvement in FLL had a positive impact on their organization’s visibility and reputation in the community. Approximately 80% of the coaches responding to the surveys anticipate continuing as an FLL coach this year.
  - Parents also were generally satisfied with their involvement in FLL and were not seeking to expand it beyond a basic level of support. While the majority of parents reported their involvement in the program as limited, most attended at least one FLL event, and the large majority rated those events as “Good” or “Excellent.” In general, parents were satisfied with their level of involvement, with some seeking to become more involved. However, the large majority expected to continue at the same level. Ultimately, their primary connection to the program is through their children’s participation, with relatively few parents expecting to be involved once their children leave the program. At the same time, parents do suggest that more and better information, in particular better information for parents about the program, would help to increase parental involvement.

### *Improving FLL*

- **Finally, in response to questions about how to improve the FLL program, coaches, parents and team members pointed to several areas for improvement.**
  - The area most targeted as needing improvement in 2008 was the Project, with comments ranging from a request that it be dropped as an element in FLL to a much larger number of comments suggesting the need for a simpler project, clearer guidelines, examples and supports for teams, etc.
  - Other areas suggestions for improving the program included improved judging (more consistent, better feedback); the need for expanded curriculum and training resources for teams; and suggestions for changes in the number and timing of tournaments (more opportunities to compete, longer season); better definition of adult roles; and addressing the age difference among older and young youth.
  - The survey questions also included a variety of positive comments on the program, reinforcing the basic survey data showing a general level of satisfaction with the program, while highlighting specific areas still in need of improvement.

### **Conclusion**

The primary conclusion for the 2008 study is that FLL continues to be successful in providing a positive and engaging learning experience for young people and in generating a variety of positive outcomes for participating young people and adults. According to all three of the

sources used in the study – coaches, team members, and parents – as a result of FLL team members show an increased interest in and understanding of science and technology, become more motivated towards learning, and gain a critical array of life and workplace-related skills, including teamwork, time and project management, problem-solving, and communications skills, and gain confidence in their own skills and abilities. Participants rate their program experience highly and most hope to continue their involvement in FLL and other *FIRST* programs in future years. Coaches and parents also rate their experience with the program positively and expect to continue their involvement.

The results from 2008 largely mirror those from the 2003 study, with results that are surprisingly consistent in terms of program implementation and impacts. In that regard, the 2008 results can be seen as further validation of FLL's positive evaluation results – the fact that the program has generated comparable findings twice during the past five years indicates that FLL is providing a consistent, as well as positive and engaging experience for young people.