

Reflections on Mentoring FIRST LEGO[®] League

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Abstract – FIRST LEGO[®] League (FLL) is a robotics competition for children ages 9 to 14. Regional and state competitions are held yearly around the nation. Each team must design and program a LEGO[®] MINDSTORMS robot capable of completing specified “missions”. Teams are also judged on a research project, teamwork, and robot design. The theme for the 2009 FLL challenge was transportation. This paper focuses on personal mentoring reflections from experiences mentoring a FLL team at a local elementary school. As a mentor, help was provided to the team to organize the design effort and provide guidance to the team whenever technical questions or conflicts arose. Reflections include a self-assessment as well as an assessment of the team, the benefits and learning opportunities provided by the mentoring experience, and an explanation of how others can get involved in similar FLL mentoring experiences.

Keywords: FIRST LEGO[®] League, K-12, mentoring

INTRODUCTION

For Inspiration and Recognition of Science and Technology (FIRST) was founded in 1989 by inventor Dean Kamen. Its mission is “to inspire young people to be science and technology leaders, by engaging them in exciting mentor-based programs that build science, engineering and technology skills, that inspire innovation, and that foster well-rounded life capabilities including self-confidence, communication, and leadership” [1]. FIRST accomplishes this mission through several global competitions designed to involve students in engineering at a young age. One of these competitions is FIRST LEGO[®] League (FLL). FLL is a robotics competition for students ages 9 through 14. The competition is centered on designing and building LEGO[®]-based robots to complete tasks on a themed playing surface. This paper will focus on reflections from mentoring the 2009 FLL team at Margaret Beeks Elementary School. This includes an explanation of the 2009 FLL challenge, an assessment of personal learning and growth as a mentor and of the team members as a functioning unit, and how others may benefit from getting involved with FLL.

The 2009 FLL challenge is called “Smart Move” and it is centered on efficient transportation of people, goods, and services. The challenge consists of two parts: “The Project” and “The Robot Game”. FIRST selects new topics each year which are related to the challenge theme and relevant to current real world issues of importance. Overall competition scores for each team are based on four judging categories: robot design, teamwork, the project, and robot game performance. Although the robot game is the most exciting part of the competition for both students and adults, each category is equally weighted in tallying the final score.

The challenge for the 2009 project is to identify a problem with the way things (people, animals, information, etc...) move within one's community, research the problem and come up with an innovative solution, and share this information with the community. Each team gives a presentation of their findings to the judges at the competition. The robot game was played on the Smart Move themed playing surface, shown in Figure 1. Teams can complete any number of the nine challenges, or “missions”, for a maximum score of 415 points. The robot game missions range from accessing different areas, to transporting passengers and objects around the playing field, to surviving impacts with other vehicles. Each mission relates to real world transportation scenarios. The robots are built from LEGO[®] Mindstorms NXT kits which consist of a variety of sensors, motors, and a small computer to control

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everything. The robots are programmed to accomplish the given tasks using LEGO® Robolab software which is a simplified version of National Instruments LabVIEW.



Figure 1 - 2009 Smart Move Playing Surface [1]

MENTORING

The definition of a mentor is “a wise and trusted counselor or teacher” [2], while an advisor is “one who gives advice” [3]. The personal relationship that is developed between the mentor and the protégé is where mentoring differs from advising [4]. This is what makes mentoring a key element in the development of young engineers. At all levels of education, the relationship built through mentoring facilitates learning and growth of the student.

The Margaret Beeks Elementary School 2009 FLL team consisted of eight 4th and 5th grade boys, competing in Division 1 (ages 9-11). When first introduced to the team as a mentor, they were still in the beginning stages of the challenge. The boys were unfocused and disorganized. They just wanted to play with LEGO®s and their friends for an hour and a half after school, the reason many of them probably signed up for FLL. In the first meeting the head coach explained all the challenges to the team, having each member read one of the robot missions. This was an easy way to get all the team members involved immediately. We split the team into three groups, programming, robot building, and project research. Each meeting a new team leader was designated and team members were rotated through the groups to give everyone a chance to work on the different aspects of the challenge.

As adult leaders we set up a structured environment in which the team worked, but the coaches and mentor were only there for guidance and technical support. The best way to have the team learn was to let them solve problems on their own. For the first few meetings we had to routinely keep the team on task. They were frustrated with all the different possible configurations of the robot that could be made. As the competition drew closer and the team decided which missions they wanted to complete, the team became more focused as they began to see the results of their work.

The team decided to build a robot with tracks instead of wheels in order to traverse the obstacles on the playing field and access the yellow and black target. They were able to program the robot to access this area without using any sensors, relying solely on the ability of their computer program to maneuver the robot accurately. The team was able to achieve their goal of accessing the target, with a maximum score of 245 points in doing so.

For their project, the team decided to focus on improving the bus transportation in their community. They researched the topic at the library and visited the local bus depot to learn firsthand about how the bus system works. Their solution for improving transportation efficiency and environmental friendliness of the bus system was to incorporate biofuels and solar panels into all new busses and convert existing busses to the new fuel source. The team prepared a video to show their solution and present to the judges.

The team received excellent marks in the teamwork and project categories. They also performed well in the robot performance category, achieving one of the highest overall scores at the regional competition. However, the decision not to use any sensors on the robot cost the team several points in the robot design category. The team placed well overall at the competition, but unfortunately they were not selected to attend the state championships.

Participating in FLL was a great learning experience for everyone on the team including the parents and coaches. The students learned how to be a successful member of a team, and how to lead a team towards a common goal. With a little guidance and direction they were able to come up with a creative solution for overcoming the obstacles on the playing field. Everyone on the team also had a chance to learn the basics of computer programming, which is quickly becoming a crucial skill for engineers to possess. Developing these skills of problem solving, teamwork, leadership, and perseverance will be beneficial to the students throughout their careers in any field.

As a mentor, it was surprising how much was learned from the students. Several times the boys quarreled over the robot design, and the mentor had to practice mediating a conflict resolution. A great deal was learned about the dos and don'ts of mentoring young students. It was thoroughly an enjoyable first mentoring experience that has led to plans to stay involved with FLL, and recommendations to anyone with an interest in engineering education.

Mentoring or coaching an FLL team is a great way to get involved in teaching young engineers. Becoming a mentor is easy and the time commitment is a minimal 2-4 hours a week from September to November. Tournaments are held yearly around the world. The regional tournament and contact person nearest you can be found at: www.usfirst.org.

SUMMARY AND CONCLUSION

FIRST LEGO® League is a robotics tournament, organized by FIRST, designed to get children ages 9-14 involved in engineering. Students build and program their LEGO® Mindstorms NXT robots in preparation for regional tournaments held each year. Teams that perform well are invited to attend the state and then national championships.

FLL is a rewarding experience for everyone involved. Each year the tournament initiates thousands of young engineers from around the world, introducing them to the basics of computer programming and engineering design. FLL enhances skills needed to be successful in all aspects of life both professionally and personally by promoting teamwork, leadership, enthusiasm for science and technology, skill building, and self confidence. It also builds a bond of mentorship between team members and coaches.

REFERENCES

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