

The BEST way to recruit and retain students
Sheila Horan
Klipsch School of Electrical and Computer Engineering
New Mexico State University
Las Cruces, NM 88003
sheila@nmsu.edu

A program to encourage students to look into engineering, science and technology has been developed. This program is called BEST (Boosting Engineering, Science and Technology). A team of students from local area high schools and Jr. highs (or middle schools) design and build a radio-controlled machine to accomplish a defined task. Students already in the university program help with the engineering of the contest. This paper will look at what is involved and how students become excited about science, engineering and technology.

Introduction

Founded in 1993, the BEST (Boosting Engineering, Science and Technology) non-profit community based volunteer organization program was formed to address the lack of peer acclaim for academically successful students. BEST gives public recognition of the students' successful use of technology, engineering and science in a sports-like competition that mimics the product design-to-market cycle. This organization has grown to 14 local hubs in 5 states with a hub play-off of the best BEST teams. Texas A&M has hosted the play-off for the last five years. The formalization of the program led to the formation of the non-profit corporation – BEST Robotics Inc (BRI) which now handles the over all game, manuals, quality control and assistance to hubs. They maintain a web site at <http://www.bestinc.org>. By the fall of 1999, BRI included 250 teams at 14 hubs with over 3800 students participating. The organization strives to combine local schools, communities, businesses and industries to support and participate in their local hub. The students design, construct and test their radio controlled robotic vehicle. By doing so, they learn about the how and why things work. They learn about teamwork and consideration of various factors that influence the design of the product. As students learn more about the engineering of the robot, they can start to think about engineering as a career. Each team has a mentor to help guide them through the process of design and construction. Students from the university can assist in the process, using information they've learned in class and applying it to the projects to help trouble shoot or give insight into techniques that could be used in the designs. Active involvement in ones major leads to retention of students.

How it works

First a problem is formulated. One of the hubs comes up with a game task description. In one previous year, it was a toxic waste spill and the robot had to recover items from the spill. Another year it was the Great Alien Escape and the goal was to rescue aliens from a spacecraft. This past year it was Pandemonium in the Smithsonian where there was a fire in the Smithsonian and the robot had to go in and do fire control and recover certain artifacts.

Once the task is decided, then the game area is designed. Items needed for building the robot are assembled and boxed up for the individual teams. Every team gets an identical box of parts to build their robot.

Finally the kick-off meeting is held early in the school year. At this meeting the schools pick up their boxes and rules and observe the game area and what the problem for that competition will be. The main idea is to have the teams experience the same challenges that engineering teams face when taking a product from the need identification to the product. Each team receives an identical box of parts. This represents material constraints. The motors, radio controllers, and main electronics will be returned at the end of the contest, the rest of the materials can be used as the team wishes. Each team has 6 weeks to design, build and test their robot. This represents the time constraints. Each team will have the same size and task requirements they will need to meet.

After five weeks of work, the teams are invited to test their robots. A mall or museum day is held where the teams come together and try their robots on the actual playing field. People from the community are invited to come and see what the teams have been doing. The teams get to see how their robot works and get ideas from other teams. Then they have one week before the competition to fine tune their robot.

During the competition day, all of the teams get the chance to do their best. During the competition each team is judged according to:

1. Reliability of the robot

2. Write-up and documentation of their work
3. public speaking – each team tells what they did and talks about their robot
4. the appearance of the machine
5. participation of the team members – how many students were involved
6. community involvement - spreading the excitement of engineering, science and technology in their schools and community.
7. How well the robot performs (it will be competing against 3 other robots each time). The competition is split into two sessions. The first is a seeding round and sets up the pairings for the play offs in the afternoon. The afternoon session is a double or triple elimination round, and only the robots that score well and run well continue on to find the winner.

Awards are given to the team that “wins” in the competition play, to the team that scores the highest overall points in all of the areas, to the team that has the most reliable robot, and also given for school spirit and for T-shirt design. One overall winner is selected to go on to the final play off at Texas A&M. All teams get a plaque and a lot experience.

The teams need to put in the time and effort to do the work, furnish transportation to the events, find a place to build their robot, and furnish their own T-shirts.

What happened

The fall of 1999, Zia Middle School in Las Cruces participated in the West Texas BEST competition. The Zia Science club sponsored the Zia team. The team consisted of 37 students at one point, 20 of the students went to Lubbock for the competition. Engineers from NASA White Sands Test Facility, and the Klipsch School of Electrical and Computer Engineering at NMSU helped mentor the team. The students were very excited, and worked very hard. By the end of six weeks, the team had the Zia Thunderbot. At the competition, the students learned a lot from the other schools about ways to build robots. In the seeding competition, they finished 8 out of 25, and in the final rounds they finished 13 out of 25. After the competition, the students watched the video they recorded and filled out a survey for the program. The tabulated results of the survey are in Table 1, and a copy of the survey follows the paper. The responses were ordered from 1 being strongly disagreed to 5 meaning strongly agree. Most of the students' favorite class was science, and the least favorite was literature composition, however, many of the students indicated that math was their least favorite class. Although the students are neutral about the program making them likely to consider engineering as a profession, they did agree that it made them more curious about how things work and may encourage them to pursue a more 'hands-on' career than other work. Many students had worked in teams before, so that experience was not new to them. Students did indicate that overall it was a good experience, that they learned a lot and would encourage their friends to participate in it next year. BRI is working on ways to statistically verify the impact that the program has had, but has not had the resources to do the studies. They have received anecdotal stories of change brought about by the program. One teacher reports that her all-girl algebra class that participated in the BEST program now is willing to experiment and create new solutions when then hadn't done that in the past (1). A physics teacher reported increased enrollment (from 10 up to 30) after participating in the BEST program (1).

On the retention side, many freshmen come looking for jobs they can do within the department where they can use the knowledge they are learning. This would give those students the perfect opportunity to use the knowledge, develop more hands on experience, and through explaining what is going on to the students, learn the information better themselves. This will increase confidence and help the students to feel valued in the department.

Conclusions

The BEST program helps pull together communities and introduce students to engineering without intimidation and by making it a fun sports like activity. If NMSU became a hub, we would be able to bring students to campus, increasing their visibility of the university, enable them to interact with our own students – which would give them a tie to the university, and help them to see what engineers do. In this way, we recruit students to NMSU. We help retain our students by hiring students to help with the program, and giving them a sense of fulfillment. They act as ambassadors for the university and gain pride in what they do. This makes them more likely to stay at NMSU. The BEST way is a great way to recruit and retain students!

References

1. Chicago BEST web site, <http://www.chicagobest.org/bri.htm>

Table 1 Zia Student Survey Results

Student	Sex	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	
1M		3	2	5	5	4	5	5	5	3	5	5	5	5	4	1	2	5	4	4	3	3	3	4	4	3	3	3	3	3	3	
2M		3	4	5	5	5	3	4	5	3	5	5	2	5	4	1	5	3	3	3	3	5	4	5	4	4	5	4	3	1	5	
3M		4	5	5	5	4	3	4	5	4	4	4	4	4	5	3	4	3	4	4	5	5	4	5	4	5	5	4	3	4	4	
4M		3	4	5	3	3	3	3	3	3	3	2	3	5	2	5	5	3	5	3	4	3	3	3	3	3	4	3	4	4	3	3
5M		3	4	5	5	4	5	3	4	3	4	3	4	4	4	4	4	3	3	3	5	3	3	2	3	3	3	3	3	1	3	
6M		2	2	2	3	3	4	3	2	4	1	4	3	4	2	1	2	3	1	1	3	3	3	3	3	3	3	4	3	3	2	
7M		1	5	5	5	3	3	1	5	5	4	4	3	3	4	4	5	4	3	2	4	3	5	4	5	4	3	3	4	1	2	
8M		3	4	4	5	5	5	4	5	5	4	5	5	5	5	3	4	5	4	3	5	5	4	1	5	5	4	4	4	5	5	
9M		1	3	5	4	2	4	2	5	1	4	3	1	3	3	2	3	3	2	1	3	3	1	1	1	1	1	1	1	1	1	
10M		5	4	5	5	4	5	4	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
11M		4	1	1	1	4	4	4	4	4	4	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
12F		3	4	5	5	4	5	4	3	3	4	3	5	4	5	4	2	4	4	3	4	3	4	2	3	2	3	4	4	5	4	
13F		3	4	5	5	4	5	3	5	4	5	5	5	5	5	1	4	4	3	2	4	3	5	3	3	3	3	4	2	3	1	
14F		2	5	5	4	5	4	4	2	4	3	5	5	5	5	4	4	5	5	5	5	5	4	5	5	4	5	5	5	5	5	
15M		3	3	5	4	2	4	3	2	2	2	3	3	2	2	1	3	3	1	3	4	2	3	4	3	2	3	3	2	2	2	
16M		4	5	5	5	5	5	5	1	5	4	5	5	5	5	1	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	
17M		3	5	4	3	4	5	4	5	3	4	4	2	4	5	3	5	4	4	5	4	4	5	4	4	2	3	3	4	4	3	
18M		3	4	3	5	3	4	4	3	3	4	5	3	4	4	1	3	3	2	3	3	3	3	3	3	3	3	3	2	4	3	
19M		4	4	5	4	5	3	5	5	5	5	5	4	5	4	5	4	5	2	4	5	4	5	3	4	5	4	5	4	3	5	
20M		4	5	5	4	5	5	5	5	5	5	5	4	4	5	2	4	5	5	4	5	5	4	5	5	5	5	5	5	5	5	
21M		3	4	5	4	4	3	5	5	4	5	5	5	5	3	4	4	4	4	3	4	4	5	4	5	4	5	4	3	3	3	
22F		3	1	1	3	3	1	1	3	2	1	2	3	2	2	2	2	2	2	3	3	2	2	2	3	2	2	3	2	2	2	
23M		3	4	4	5	4	5	4	3	4	5	5	5	4	5	1	1	4	3	3	1	4	4	4	4	3	5	3	4	5	5	
24M		4	5	5	3	5	5	5	5	5	4	5	5	4	5	5	5	5	4	4	5	5	5	5	5	5	4	5	5	5	5	
25F		4	4	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4	5	5	5	4	5	5	5	5	5	5	5	
avg		3.2	3.9	4.5	4.4	4.2	4.4	4.0	4.3	4.1	4.4	4.2	4.0	4.3	4.2	3.0	4.0	4.2	3.8	3.6	4.4	3.9	4.0	3.7	4.1	3.8	4.0	4.1	3.9	3.8	4.0	

Favorite Class math 4 science 20 Soc stud. 1
 Least Fav classes Lit. 15

Proposed BEST Participant Survey

Demographic Information

Last Name
(Type Name Here)

First Name
(Type Name Here)

Middle Initial
(none)

BEST 2000 team
(Type School Name Here)

HUB
(click to select)

Age 0

Male
Female

Primary Role on Robotics Team
(select most appropriate)

Do you think other team members would consider you to be one of your team's "leaders?"
yes no

How many years have you actively participated in the BEST program? 0

Do most of your close friends participate in the BEST program?
yes no

What classes do you like MOST in school?
(type your answer here)

What classes do you like LEAST in school?
(type your answer here)

What are your parents' professions?
(Parent 1: ?)
(Parent 2: ?)

Testimonial: In 50 words or less how would you summarize your BEST experience?
(Your summary might be used in future BEST Inc. publications)

Do you have any suggestions for BEST Inc. to make the program better?
(type your suggestion here)

The following statements represent areas of interest to BEST Inc. For each statement, please indicate the level of your agreement with the statement by checking the appropriate box. Please do not simply provide the answers that you think we "want." Your honesty will help us better the BEST program for future participants.

General Perceptions

Strongly Disagree Disagree neutral Agree Strongly Agree	
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	1. As a result of my experiences in the BEST program I am more likely to consider engineering as a profession
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	2. Among my group of friends I think the BEST program does more to increase interest in engineering, science, and technology than any other program that I know of.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	3. I have always enjoyed designing and building things.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	4. Most of the work of designing and building our BEST robot was done as a team effort and seldom did any one person dominate the decisions.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	5. I will probably encourage my friends to participate in future BEST competitions.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	6. Though our BEST team was responsible for designing and building our robot, our coaches/mentors kept us on schedule and planned most of the meetings.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	7. As a result of my participation in the BEST program I now find myself more curious about how things work.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	8. As a result of my participation in the BEST program I am more likely to pursue a more "hands-on" career than a "computer related" or "office" job.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	9. Our BEST team was very unified and had a specific goal that everyone agreed on.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	10. My participation in the BEST program has given me ideas for new interests and hobbies.

Relationship Building

Strongly Disagree Disagree neutral Agree Strongly Agree	
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	1. Overall, the experience of working with my BEST team has been a very good learning experience.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	2. As a result of my participation in the BEST program I have developed friendships with other students who I normally would not have been friends with.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	3. I have learned a lot of things about engineering and science from the mentors that worked with our BEST team.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	4. Our mentors and coaches wound up developing pretty good relationships with most of the students on our BEST team
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	5. The BEST program is one of the first times I have really had to work as part of a team.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	6. I think that the BEST program is as effective as any sport in teaching students how to work as a team.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	7. As a result of my participation in the BEST program I have learned how to better communicate my ideas to other people.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	8. During my participation in the BEST program I have learned a lot about the companies that sponsor my local BEST hub.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	9. I believe that companies that sponsor the BEST program are probably among the better companies to work for.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	10. The first time I ever heard of the companies that sponsored this year's local BEST competition was at a BEST event.

Technical Learning Experience

<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	1. As a result of my participation in the BEST program I now have a lot better understanding of physical principles (like how gears work or how electricity works).
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	2. As a result of my participation in the BEST program I now have a lot better understanding of how things are built and the advantages of various types of materials.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	3. During my participation in the BEST program I learned how to use construction tools that I had never used before.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	4. During my participation in the BEST program, I gained a better understanding of concepts that I learned in physics/science classes.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	5. As a result of my participation in the BEST program I have learned a lot about how engineers work in the real world.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	6. As a result of my participation in the BEST program I now have a better understanding of what engineers do for a living.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	7. During my participation in the BEST program I have learned a formal method to approaching complex problems.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	8. I believe that the process that my BEST team followed in designing our robot is very similar to how real engineers design things.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	9. Our mentors and coaches encouraged my BEST team to stick to a specific method or approach to solving problems.
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	10. Our mentors and coaches encouraged us to do a lot of drawing, thinking and studying outside of our meetings