AC 2011-528: BEST PRACTICES FOR STUDENT ROBOTIC CAMPS

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A Model for Summer Robotic Camps
(Its Theme, Tool, Toy, and Trick)

Abstract

For six years the Florida Advanced Technological Education Center, FLATE, an NSF-ATE Regional Center of Excellence, has been involved in summer robotics camps for middle school and high school students. The camps have grown from a partnership with other organizations to a fine-tuned FLATE organized and executed summer STEM experience. The camp's theme: "*technology is more fun when you actually know what is going on*," is based on the science, technology, engineering and mathematics needed to actually "know what's going on" with the emphasis on the T&E components of the camp's STEM activities. The camp's "*Tool"* is robotics, its "*Toy"* is the Lego Mindstorm™ robot, and its "*Trick"* is to dissolve the robots into an environment where the technology is the star and seeing the results of their own engineering decisions is the reason campers are having fun.

This presentation elaborates on the mechanics of the *"Toy"* (learning to assemble and program the robots), the *"Tool"* (using various robotic sensors, exploring various design options, and evaluating selected robot configuration performance), and the *"Theme."* Theme activities include participating in several challenge competitions, learning about modern advanced manufacturing via on-site and online visits, and adding personality to robots via a FLATE inspired DS Solidworks™ modified version of their student edition design software package. The paper also provides logistic details for creating and operating your own camp. These details are based on FLATE's cumulative experience with over 400 camp attendees with 200 participating in the summer of 2010, the operation of camps exclusively for girls, and the export of camps to off site locations. Initial follow up details about attendees is also provided.

Background

Science, technology, engineering and mathematics (STEM) curriculum represents an innovative approach for education with respect to content for and relevance to the targeted K-12 student population. This increase in STEM awareness triggered the NSF-ATE regional center for Advanced Technological Education in Florida (FLATE) to develop a major program to help Florida's K-14 educators, K-12 and community college faculty, integrate STEM into the classroom environment. A corollary to this effort included the creation of a STEM summer camp experience for middle and high school students. The distinctive characteristic of all of FLATE developed materials including its summer camp design is a deliberate focus on the technology and engineering components of STEM. This sTEm approach is not to belittle science and mathematics but to emphasize our belief that science and math are basic constructs that allow engineering to bring a technology into practice. Without this shifted sTEm perspective, many activities conducted under the STEM pinnate often digress into standalone activities in science or mathematics with peripheral lip service to engineering and a blind use of a technology (usually a software package) as the T&E elements. Such digressions may certainly strengthen science and math skills, but such a silo based approach does not represent much of an innovation in education and does very little to help students grasp that connection to engineering and technology.

FLATE's robotics camp provides an environment for participants which blends science and mathematics seamlessly into the camp's theme: "technology is more fun when you actually know what is going on" without much, if any, fanfare about the science or the math. Campers know what their goals are and appreciate that science and math will help accomplish objectives that lead to a completed goal. This paper presents a detailed description of FLATE's robotics camp that includes the robot, (the Toy), and robotics, (the Tool). It also expands on how the camp accomplishes its theme as well as the specific details on operating a camp. The camp logistic details are provided first.

Summer Robotics Camp

Running a summer Robotics camp is not a low energy, minimal resource or non-stressful activity, nor is it for the faint at heart! It is, however, an exciting adventure with energy and money beginning to flow way before the camp begins. For convenience it is useful to trisect the entire camp experience into pre-camp, camp and post-camp components.

Pre-camp

Although making money is not the goal of most robotics camps, organizers must still collect money and must distribute those funds to meet the needs of the camp. This reality leads to the first decision. Is your summer robotic program(s) going to be operated by a not-for-profit entity, or is it being conducted to earn revenue? Revenue generating types of camps, a for-profit organization, will include different planning, budgeting, and taxation concerns not discussed here and our recommendation is to organize your camp within a not-for-profit structure. Either way, there are two general avenues for funds that camp organizers can pursue to assist in financing the programs: outside funding and internal funding.

Outside funding can be secured through industry sponsors, private, and/or local organizations, individual contributions, and grants. Some materials for the camps may be secured through donations or product promotion versus being purchased by the camp organization or camp participants. Inside funding may come from the academic institution or one of its internal organizations, student government for example. Either type of funding source can also be approached to consider whether they will provide scholarships or grants to assist with camp registration. This is a particularly attractive idea to donors with respect to helping the camp meet specifically stated diversity objectives.

There are also two different cost categories which will be incurred by the camp, one-time expenses and recurring expenses, and the structure of the camp can determine whether a cost occurs once or several times. Examples of one-time expenses include initial equipment costs and personnel professional development. Needed computers if not available for temporary use and software, for example, will be reused during the various sessions but can be considered a long term investment with minimal maintenance requirements and thus fall into the one-time expense column. However, as determined by the camp's structure, the robots themselves can be an example of a recurring expense. If the robots are repeatedly reused and usually mildly abused

by different camps during the summer, then the cumulative initial and maintenance cost should be prorated as a recurring expense.

For FLATE, as an example, each of our 1 week duration camps cost about $120/camper on average to run. This is an estimate of our recurring expenses such as snacks but not lunch, disposable supplies and materials, take-away items such as "T" shirts and does not include the investment in new and replacement robots. FLATE's home institutions, Hillsborough Community College, St. Petersburg College, and the College of Engineering at the University of South Florida do not charge for use of facilities and FLATE's general policy when operating off-site camps is to require that the host institution cover any facility usage fees.

In addition, FLATE wants its camps to be as inclusive and fulfilling as possible. To accomplish this objective, FLATE only charges a $50/ camper registration fee and limits camp enrollment to 24 campers per week. Thus, we have to actively solicit sponsors to offset the actual camp cost. Fortunately, when any deficit spending does occur it is currently covered by discretionary funds from FLATE and our administrative institution, Hillsborough Community College.

In addition to camp finances, camp attendance is an important pre-camp priority. As implied earlier, all phases of a robotics camp are energy and resource intensive. Although it may be tempting to ignore this suggestion, you will need to have a camp coordinator on board and directly involved in all pre-camp activities. This is particularly the case for camp advertising, marketing, and diverse camper recruiting. Although FLATE camps have an upper participant limit, there is a critical mass of campers required to foster the camaraderie characteristic of a fun experience. Actions to guarantee that minimal enrollment are an important pre-camp activity.

There are several approaches to securing the camp's targeted enrollment. These include placing ads in local newspapers or online with local news stations. FLATE uses www.myfoxtampabay.com, for example. There are also lists of summer camps that are advertised on "camp" websites. FLATE uses www.summercamps.com and its own website, www.fl-ate.org/projects/camps.html.) Other more traditional activities include hanging posters (in as many places as possible) and handing out flyers at every local event even remotely connected to your student recruitment group. Many of our campers found out about the camp via local or community broadcast news or newspapers.

Once you have conducted a camp, e-mailing flyers to past campers (parents) with the request that they pass the message along is very productive way to "hit" new parents. Two other e-mail tasks are mentioned here for completeness. First, e-mail parents during the camp week about daily activities and special events or field trips and second, after the camp sending a "thank you" e-mail to campers and parents with a few pictures to highlight the camping week builds a lot of good will and warm memories about their camp experience. Finally, in order to overcome perpetual parental uncertainty, nothing takes the place of one-on-one contact. Clearly, there are lots of things to do which require some or even considerable effort and follow through and that suggests, again, that there needs to be a designated camp coordinator on-board and accountable from the beginning of the project.

Camp

The actual camp itself has several characteristics that must be in place to assure its success. First, there are physical requirements. Choose a location which is easily accessible for staff, campers, parents, and any special needs. The facility should have adequate no hassle parking for staff and a drop-off area for children. Aside from the usual classroom type space with desks and chairs, the robot challenge layout area requires a minimum 20 square feet of open level flooring or carpet (a square space, 20 feet on each side) that can be marked with a roll of painter's tape (the blue kind) to denote the boundary conditions for the various robot course terrains. It is also preferable that the classroom or its equivalent is equipped with computers and a LCD or Elmo type projector within easy access to the challenge layout area. FLATE recommends 1 computer per 2 campers with an easy walking by space between each computer setup. It's also helpful if instructors have Internet access within the teaching area. This feature allows instructors to show campers online videos and demonstrations to compliment camp activities. For example, FLATE camps use Stanford University's website, http://manufacturing.stanford.edu/, "How Everyday Things Are Made" to relate to the manufacturing component of the camp.

Next there are "warm and fuzzy" requirements. The drop-off area is an important example. Parents are used to seeing where their children go right after they are dropped off but want easy access off of the property, so select the child "docking station" with care. In addition, parents feel more confident when they have the opportunity to speak to someone who is not only knowledgeable, but who will actually be in attendance at the camp. Thus, make sure the same knowledgeable camp representative is at this location during the scheduled time that campers are being dropped off and picked up. Naturally, the facility should have clean adequate close proximity non-locker room restrooms that can accommodate the staff and campers. It is also important to remove, as best as possible, the classroom atmosphere by bedizening the space with posters, displays, and paraphernalia and be sure to point the way to the camp with colorful, artful, and coruscated signs.

Finally, there are the "cover your bottom" requirements. Make sure you have signed photo releases and do not take face shots of campers that you don't have releases for. That same release can have a yes/no allergy declaration as well. Do not assume anything about insurance except that you need it and right now you might not have it! Please remember that your camp has kids in it and kids will always be kids so have a minor emergency plan in place for bumps and bruises.

Post-camp

The post-camp component of your camp is important and also susceptible to an inadequate amount of attention. For continuous improvement, camp surveys must be administered. These instruments are designed to get feedback on camper experiences, determine parent follow up activities triggered by the camp experience, and establish camper leads for the camp next summer. A great post-camp follow up activity is to have a "Parents' Night" that includes campers. This is an opportunity for to you talk about the STEM focused school programs in your area. Invite a representative from your school district to review available academic programs. Include a Question and Answer session that is seeded with questions to get the information exchange process started. Take the opportunity to make a presentation on the importance of STEM subjects in the school curriculum, to promote next year's camp, to show off college labs,

and of course, another chance to take pictures! FLATE always includes food and door prizes for these events and one of these prizes is always a Lego Mindstorm™ robot. Again, FLATE is fortunate to have partners who will help cover these post-camp costs.

Robotics Camp Theme

FLATE summer camps are designed to introduce campers to the world of robotics and automation so they can then conceptualize robot applications in both industrial and personal arenas. In this case, familiarity does not breed contempt, it bolsters camper confidence and, at the risk of being battological, also confirms that "technology is more fun when you actually know what is going on." Including a trip to a facility that incorporates robotics into their operations is a great way to shift the camper's perspective from playing with a toy robot to working on a miniature robotic system. This broader view is important for them to appreciate the similarities in what they are doing during camp activities and what really happens in an engineered manufacturing, production, or processing environment. Good candidate tour targets include facilities that use robotic arms. These operations can vary from automated welding and warehousing facilities to materials and medical testing laboratories. The local soft drink bottle filling plant is a great place for them to see an alternative form of high speed robotic operation performed by robotic systems that don't even come close to their preconceived image of what a robot should look like or do. The key point is to have the campers see robotics in action, the complexity of that action, and the impossibility of humans performing the same tasks.

Robotic Systems

The benefit of using robotics as a camp "Tool" is the degree of learning freedom that robotic systems provide. These benefits are reaped from multilayered perspectives. Submerged in the camper's subconscious is a mystic aura that surrounds robots that can be tapped to assure initial enthusiasm. From a conscious pragmatic perspective of accomplishing a sTEm learning objective, a robot system has it all and, at the risk of also being perceived as Lego investors, the Lego Mindstorm™ robot is a great representation of a robotic system. Its elements are ideal for subtle and substantive science discussions. A review of the sensors it employs relative to the appropriate physics concepts utilized is important. Inserting these principles into the discussion early in the week will help reinforce the idea that a higher probability of engineered success with the "challenge competitions" later in the week will come from robot component knowledge and subsequent expostulation rather than observation and repeated sequential heuristic exploration.

Addressing the robot sensor set from a holistic perspective will also be rewarding. Analogous discussions with campers about environment detection by humans as compared to the Mindstorm™ robots can be opportunistic and open ended. Your objective is to have each camper begin to contemplate how humans acquire the initial non-judgmental data needed to function. As the week progresses and the challenge activities become more complex, returning camper conversations to the comparison of what humans do to accomplish the task as to how they get the robot to do the task will be interesting and sometimes amusing for you but useful and rewarding to them. Most likely this will be the first time these campers will be introduced to the difference between human simultaneous multiple sensor data input as compared to the serial nature of robot sensor data input.

This relatively open-learning but somewhat rigorous discussion platform about the physics behind the robot sensors provides the segway to quantification of the sensor performance. The transition conversations from general sensor operational theory to actual estimation of performance expectations as supported by the operational theory are an essential part of the camp experience. This entire phase of the camp should be somewhat transparent to the camper but your objective is to have each camper gather data about sensor response to its appropriate stimulus before the camper begins any integrating robotic activity. Campers should have an expectation of what might happen before they actually observe what happens. A simple starting activity would be to have campers estimate and then determine the distance limits of the robot's object detector followed by estimation and determination of that detection capability as a function of angular position of the object relative to the sensor. Repeating these quantitative preliminaries with each sensor followed by discussions as to if and they how the sensors might constructively or destructively interfere represents the framework that supports the camp's "Theme."

Robots

As you might have suspected, the robots themselves will be the platform for the camper's engineering experience. Campers will have the tactile experience and visual satisfaction associated with robot assembly and successful test. It is in this and sequent stages of the camp that camp personnel involvement becomes critical. The camp instructor and the camp counselors must have a working knowledge of the science and math as well as comfort with robot mechanisms. They will have to deal with a range of questions, mechanical problems, and attention span situations. It is a camp and fun is part of the program but camper random, unfocused, trial and error, and time killing activity will not lead to a successful camp nor, ironically, will it result in good camp experience reviews by the campers. The camp staff must keep activities moving along and that is done by answering questions with a sprinkle of appropriately focused concise just-in-time math and science, solving real activity stopping mechanical and computer problems quickly, and constantly redirecting campers to the activity task at hand.

FLATE staffs its camps with appropriate grade level teachers and 2nd year students enrolled in A.S. technology degree programs. It is important to have the camp instructor's teaching experience matched to the camper age group. Even if a professor of engineering has a middle or high school offspring, that person is not likely to be a good candidate for camp instructor. There should always be a minimum of 2 people working with campers at all times. The camp instructor should count on being with the campers most of the time.

One of the biggest challenges with these robots as rigorous learning tools will occur during their programming stage. This complication will not be due to complexity of the programming language. The language is not complicated and that is the root of the teaching challenge.

The low energy approach to computer or robotic system programming has always been the trial and error method. However, this technique offers the lowest return on investment on the programmer learning and robot performance curves. Simple program language structures offer limited choices to the programmer. Hence, the temptation to pick one command option, see what

happens and then, if necessary, select the other command option is high. Aside from successful robot assembly and test, the major element of the engineering portion of the camp is the creation of the operating robotic system that accomplishes its tasks without repeated programming and endless "tweaking." The daunting challenge for camp staff is to adjust camper behavior patterns so that they think before they type. (By the way, typing the program is also easy since the commands are icon based instead of alphanumeric strings.) This camper attitude adjustment must be gentle but relentless with staff vigilance the key forecaster of when a camper is slipping into the low energy, low thought, low productivity trial and error school of programming. From a practical perspective, your robots will endure a lot more unintended abuse by campers toting them to and from the programming station than they receive performing their programmed task. Thus, it really is better for all concerned if camp staff require an inspection and discussion of camper programs before the robots have to deal with those programs.

At the risk of just harping about programming, it is important to realize that the robot's program is the intangible essence of the camper's robot activity. The program represents the camper's cumulative understanding of the situation. Since the robot will execute the program perfectly, the robot performance provides precise feedback that reflects that understanding. Therefore, camp staff should conduct a debriefing with the programmer(s) after every robot challenge activity. These meetings should start with camper evaluation of the robot's performance and a detailed analysis of the program's part in performance success or failures. The staff should avoid dictating programming actions to correct flaws but never leave the camper really uncertain as to what to do next. In addition, this may be a great opportunity to reinforce the difference between how the camper collects and acts on information vs. how the robot has to be programmed to accomplish the same tasks. It has been our experience that this is the first time the campers experience the impact their selected serial arrangement of program icons had on the expected performance of their robots.

Finally, please remember the "challenge competitions" do have a competitive nature but they are also camp community events. Everyone should watch everyone's robot perform the assigned challenge. In addition, some open group discussion of reasons for successful and not so successful robot performance should occur after each trial with these discussions based on the science, math, engineering, and programming contributions to the performance. All of these suggestions represent additional staff work but the camp "Theme" only really works when the camp staff really works on it.

Camp Evaluation and Follow-up

FLATE as an NSF Regional Center of Excellence has multiple reasons for conducting robotic summer camps. These camps address specific objectives of goals that support our mission. Even with that incentive, our engineering nature insists that we confirm that they represent a good use of our resources. Like most projects that are intended to make a long term impact, it takes a long time to determine the extent of that impact. However, we have begun gathering the information to make that determination and provide initial data and findings.

The first step was to compile camper as well as parent/guardian short survey results. This action provides quantitative and qualitative input to help gage if the summer camp experience impacted

student interaction with STEM subjects in the following school year. It also provides feedback to help develop additional sTEm experiences to be shared with teachers and infused into curriculum.

The survey data is collected using simple Lykert-type survey instruments that are distributed to both campers and their parents and returned on the final day of camp. Although FLATE offers both introductory and advanced camps, the same basic surveys are employed for all camps. However, some questions might be modified if a specific camp activity, a tour of a manufacturing facility for example, was new or of particular interest. All surveys include opportunities for open ended comment responses. Online versions of these surveys are available, but the paper version has a higher response rate. The follow up survey for parents is distributed online. The three survey types are reviewed below.

Camper surveys

Consolidated survey information is provided in Table 1. The questions probed the campers' impressions about the camp, their learning experience, and their current perception of their future. A survey entry could be a score of 1, strongly disagree through 4, strongly agree. (The typical "no opinion" was entry not provided.) As indicated in the table, the average scores were above a 4 rating for all questions with the exception of questions 5, 6 and 7. Question 5, I am now committed to making more effort for success in school studies, received a rating of 3.9 while question 6, the variable activity question and question 7, the Lego Mindstorms Robot was easy to use, earned ratings of 3.5 and 3.6 respectively.

Table 1: Camper Survey Question Comparison Among Camps

	Camp 1	Camp 3	Adv. Camp 1	Adv. Camp 2	South Shore	Ocala 1	Ocala 2	Pinellas	**Avg. Score**
Question 1	4.2	4.2	4.3	4.5	3.8	4.3	3.9	4.0	**4.1**
Question 2	4.0	4.3	4.5	4.3	4.2	3.9	4.6	4.1	**4.2**
Question 3	4.1	4.3	4.7	4.2	4.2	3.8	3.9	4.1	**4.2**
Question 4	4.1	4.1	4.4	4.5	4.2	4.1	4.1	4.3	**4.2**
Question 5	3.6	3.9	4.0	4.1	4.0	3.7	3.7	4.1	**3.9**
Question 7	4.2	3.6	3.5	3.9	4.1	3.6	3.4	2.9	**3.6**
Question 8	4.3	4.6	4.7	4.6	4.3	4.2	4.3	4.1	**4.4**
Question 9	4.4	4.5	4.4	4.4	4.4	4.1	4.2	4.0	**4.3**
Question 10	4.8	4.7	4.8	4.5	4.5	4.4	4.6	4.8	**4.6**
Question 6	3.6	3.7	4.1	4.1	3.4	3.4	3.8	3.5	*Question varied by camp*

The questions, actually presented as declarative sentences, are provided below. Examples of unsolicited and inquiry directed comments are also provided.

Questions:

1) I will need knowledge of science for my future work.
2) This camp gave me information about careers in manufacturing.
3) Learning to program the robot by thinking logically will help me to solve other problems.
4) The camp helped me understand the use of math, science, and technology in industry.
5) I am now committed to making more effort for success in school studies.
6) The Made in Florida video/website helped me make the connections between the camp and real world careers.
7) The Lego Mindstorms Robot was easy to use.
8) The Lego Mindstorms Robot helped me to see how automated systems are programmed and controlled.
9) The camp lessons were interesting.
10) This camp gave me information about careers in manufacturing.
11) The robot challenges allowed me to use what I learned in the lessons.

Comments:

"It was lots of fun!!!"
"IT WAS LOADS OF FUN!!! :) "
" :) I had fun!"

What will I remember the most about this camp?

"I will remember how to use and work a mindstorms toy and how to do circumference and diameter!"
"What I will remember about this camp is how to program robots and how to use light sensor and sound sensor."
"I will mostly remember how to program a robot and how robots work. Also, I'll remember how the workers helped us during the challenges."

Parent/guardian surveys

Table 2 provides the responses of 112 parents/guardians to survey questions. The scoring system was the same as in the camper's survey. The results, scores above 3.0, suggest general satisfaction with their child's camp experience.

Table 2: Parent/ Guardian Survey Question Comparison Among Camps

	Camp 1	Camp 2	Camp 3	Adv. Camp 1	SouthShore	Ocala 1	Ocala 2	Pinellas	**Avg. Score**	
Question 1	3.5	2.6	3.6	3.5	3.7	3.6	3.6	3.3	**3.4**	
Question 2	4.0	3.7	3.8	3.8	3.9	3.8	3.6	3.6	**3.8**	
Question 3	3.4	3.3	3.4	3.5	3.6	3.4	3.1	3.7	**3.4**	
Question 4	3.7	3.3	3.6	3.7	3.7	3.6	3.4	3.6	**3.6**	
Question 5	3.5	2.8	3.3	3.2	3.3	3.3	2.5	3.3	**3.1**	
Question 6	3.5	3.1	3.6	3.3	3.2	3.2	2.4	2.9	**3.1**	
Question 9	4.0	3.5	3.8	3.7	3.7	3.7	2.3	3.9	**3.6**	
Question 10	3.7	3.7	3.8	3.9	3.5	3.7	2.3	3.9	**3.6**	
Question 11	3.9	3.8	3.9	3.8	3.9	3.7	3.6	3.9	**3.8**	
Question 7	3.6	3.2	3.4	3.5		3.3	2		**3.1**	Varied by camp
Question 8	3.6	3.7	3.8	3.4					**3.6**	Varied by camp

An example survey from one of the camps (18 of a possible 24 responses) is provided in Table 3. A sample of comments is also provided.

Table 3: Parent/ Guardian Survey summary from one camp

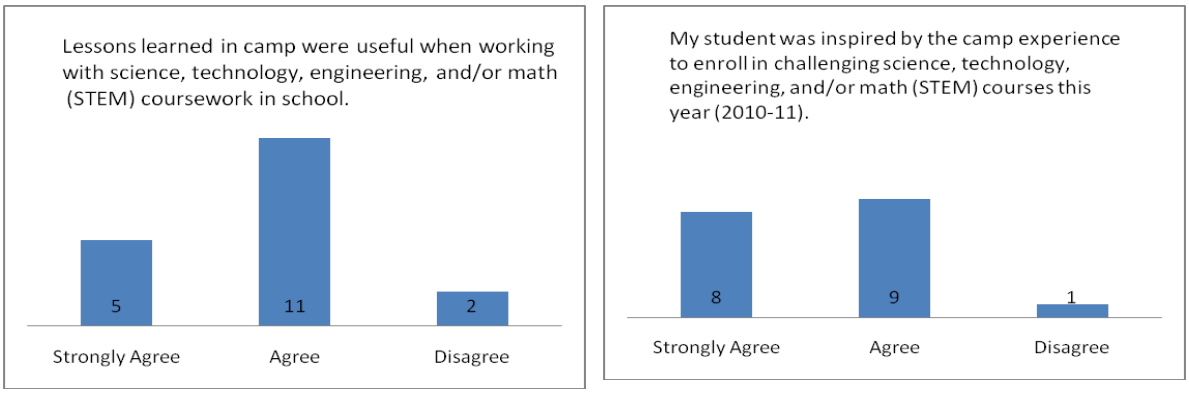
1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree

Question	Strongly Disagree	Disagree	Agree	Strongly Agree
1.) The location used for the robotics camp was convenient.			8	10
2.) The facilities used for the camp were accommodating.			4	14
3.) The Lego robotics lessons were challenging.			11	7
4.) The Lego robotics lessons were enjoyable.		1	5	12
5.) There was enough time allowed to program the "Mindstorms" and complete the numerous challenges.		3	6	8
6.) The "Made in Florida" DVD presentation and internet highlights were interesting and connected well with the camp's other activities.			7	9
7.) The SolidWorks introduction was challenging and interesting. (Introduction to flag design)		2	7	9
8.) The field trip to VALPAK was interesting and related to the other robotics camp activities.			4	13
9.) The Lego robotics instructors were knowledgeable and helpful.			3	15
10.) Overall the robotics camp was a positive experience.			4	13
11.) As a parent, I would recommend this camp to others.			2	15
12.) How did you hear about the camp? News (7) [Tampa Tribune, St. Pete Times, Brandon news, TBO.com]; Online (2); HCC Email (2); Flyer at school (2); Friend (2); USF [The library; Flyer at Lego competition].				
13.) Please provide additional comments. “Valerie really enjoyed this camp. She is very excited about going into advanced camp. However, she is disappointed there is not an all girl's [advanced] camp to attend." "The camp was very well run and had great content. It was a wonderful experience. Thank you!" "My daughter had no experience with the robots but it sounded like some of the girls did. When allowing them to program, when the more experienced girls were done, activities moved on. Frustrating. A bit more time and detailed programming explanation would have helped my daughter." "I hope you do this camp next year. We would love to do it again."				

Follow up survey

FLATE sent a follow up survey to 115 parents/guardians of campers in December 2010 and received a 16% survey completion response rate. These responses reflected the impact on campers comprised of 56% male and 44% female middle school students for the 2010-2011 academic year. It is clear from responses to the first two questions, Figure 1, that parents found the summer camp to have a valuable impact on their student's experience with STEM curriculum the following fall.

Figure 1: Parent/Guardian Follow up Survey question 1 & 2 summary response



Other questions probed into participation in extracurricular STEM or robotics club activities, list of STEM courses taken, and existence of any career counseling experiences. The local (county wide) school district for 90% of the campers may encourage or require but does not support, district wide, these activities. Thus, the impact of the camp on one parent did mimic a "wake-up" call as related to our quest to put the T&E into sTEm.

> "There were no STEM courses offered at his middle school. He is in Honors Algebra (A), and Honors Science (A+), (with lots of lab work) but no Technology or Engineering. I know the school can do a lot better on this as the kids have 2 electives and there is a full computer center (although just used for the standard classes). Hopefully they'll move forward with this before my second son gets there. I hate to think you have to attend the one Tech school to get any exposure before High School."

The general impression reflected via the survey and one-on-one conversations with camper parents is their previous lack of appreciation of T&E's role in STEM and the disconnect between the importance and practice of T&E in their child's academic preparations for life. Since we invited parents to share the name of the school their child is attending, interview and survey responses allowed FLATE to follow up with schools and provide T&E outreach and curriculum services to further serve students and educators at both the local school and the county (district) level.

Finally, what are kids' parents saying overall about FLATE's summer robotics camp experience well after that experience is over? Example responses to that directed inquiry, *Please share how FLATE's Summer Robotics Camp influenced your child's school experience this year,* are provided below.

"Zach enjoyed the class and loves science and technology. He is looking forward to attending the camp again this year. Thank you for providing this opportunity for him. I think it makes a big difference in his life to have these kinds of experiences. It shows the children so much more that is available for them."
"The Robotics camp, and the skills learned there, very much excited our son in his interest of science, robotics and math. He is looking forward to more FLATE events in 2011."
"It was a good learning experience."
"My daughter attempted to start a robotics club at school. She was unable to get any administrative or faculty support to make it happen. However, she completed a science fair project utilizing robotics!"
"One of the major advantages that we saw after the Summer program was her level of excitement about math and science. Prior to the program she didn't really understand that math is an integral part of robotics and a lot of other sciences."
"He enjoyed it a lot. I think he really liked the challenge with the computer interaction on the robots. It seems right up his alley. It is frustrating there was nothing offered at his school this year. I hope to keep him engaged in this in High school (and beyond)."
"The camp gave my son valuable problem solving skills and confidence he needs to stick with it and work through problems. This has had a trickle down effect in all of his classes. He has shown a great deal of maturity, initiative and determination as a result of the camp."

Summary

FLATE's high-tech robotics camp provides a hands on exploration experience to enhance the understanding of STEM with the emphasis on sTEm. The effort represented a partnership between FLATE and its professional society, academic, and industry partners to cultivate technical, leadership, professional, and team-building skills. Professional society and academic partners included the Suncoast Chapter 159 of the Society of Manufacturing Engineers, the Society of Women Engineers, Hillsborough Community College (HCC), and College of Central Florida (CCF) in Ocala. These camps would not happen without significant financial support from our industry partners, Valpak, Jaeger Education, Technical Training Aids, SolidWorks, Publix, and Bay Area Manufacturers Association.

This year FLATE offered three introductory robotics camps, inclusive of a "girls only" session as well as two advanced level camps at HCC-Brandon. There were 24 campers in each of the introductory camps, and 45 in the advanced camps. Off-campus locations included an introductory level camp comprising 25 campers at HCC's SouthShore campus, an "all girls" introductory camp at the YWCA in St. Petersburg, FL which had 19 campers, as well as two introductory camps at CCF which had 40 participants. The total group of 200 campers was comprised of 66 girls and 134 boys. The survey data is collected using simple Lykert-type survey instruments indicated that 100% of the campers either agreed or strongly agreed with these statements:

- Learning to program the robot by thinking logically will help me solve other problems.
- I am now committed to making more effort for success in school studies.

FLATE's experience developing a model summer robotics camp for middle and high school students articulates the goal and practice behind our "*Theme, Tool, Toy, and Trick"* based approach to emphasizing the "T&E" in sTEm by using extensive pre-planning, well organized, and professionally executed summer camp experiences. The objective is to engender interest in and promotion of the technology and engineering side of STEM curriculum to counter its current void in typical middle school STEM studies.

FLATE's camp is designed to pique student interest in advanced manufacturing through a positive exposure to robotics, and embed technology oriented problem solving experiences within a fun and active hands-on environment. Campers are exposed to new career possibilities that are based on mastery of STEM curriculum. The camp challenges provide "real world" engineering based project work within a comfortable, safe, and supportive environment to encourage students to distinguish themselves both individually and as a team, and gain experience in the practice of independence and autonomy. It engages campers within a fun and small community environment setting and reaches out to students who might not otherwise have this type of opportunity in their school. It promotes teamwork, confidence, and communication skills as positive takeaways from every group activity. Finally, it provides gender as well as unique camper population research and impact study opportunities for additional collaborative investigations with schools and STEM institutes.

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