USC Viterbi
School of Engineering

Institute for Education

CS@SC Summer Camps

Founded by Institute for Education

Summer Camps 2016 Final Report

Prepared by
Prof. Jeffrey Miller
CS@SC Summer Camps Director
Associate Professor of Engineering Practice
Department of Computer Science
University of Southern California

CS@SC Summer Camps Final Report 2016

Background

The CS@SC Summer Camps was founded in 2015 by Coach Kathy Kemper of the Institute for Education with Prof. Jeffrey Miller of the Viterbi School of Engineering at the University of Southern California to provide free computer science education to K12 students. Specifically, the summer camps target K12 students from three primary demographics:

- Under-represented ethnicities (i.e. Hispanic, African American, American Indian)
- Under-represented gender (i.e. girls)
- Low income families (i.e. families that have an annual income less than $40,000)

The curriculum is developed by Prof. Jeffrey Miller, focusing on four different languages:

- Scratch (recommended for 4th-8th grade students)
- ScratchJr (recommended for Kindergarten-3rd grade students)
- Java (recommended for 9th-12th grade students)
- Python (recommended for 9th-12th grade students)

There are Beginning, Intermediate, and Advanced levels for each of the camps, with the Intermediate and Advanced camps geared towards students who have attended one of the CS@SC Summer Camps in the past or have prior programming experience.

The camps are taught by USC Computer Science students (Teaching Assistants or TAs), both undergraduate and graduate students, across many demographics in an attempt to provide mentorship to students with TAs who have similar characteristics.

In 2015, the camps were funded by $40,000 from the Institute for Education and $20,230 from the Computer Science department at the University of Southern California. With this funding, 200 students were able to attend the camps for free in 2015. The funding covers pay for the TAs, salary for the director, lunch for all of the students each day, laptops for the students to use, advertising, supplies and equipment, and administrative overhead.

In 2016, we have greatly expanded our efforts.

2016 Funding

The camps in 2016 had seven organizational donors and 59 individual donors who contributed through a crowd funding campaign (https://ignite.usc.edu/summercamps). The funding provided in 2016 is as follows.

- Fullerton School District - $60,000
- Individual Donors - $22,816
- USC Computer Science Department - $21,058
- Institute for Education - $20,000
- Raytheon - $7,450
- Westly Foundation - $5,000
- Python Software Foundation - $3,125
- Github - $1,375
- **Total - $140,824**

All of the organizational donors are listed on the web site (http://summercamps.usc.edu/sponsors/), banner, camp presentations, and the back of the t-shirts that were given to all of the students at the end of each week.

2016 Camps Overview

All applications for the 2016 CS@SC Summer Camps were submitted through a custom registration system that was created by two different senior design groups under Prof. Miller's advisement. The system was created to be scalable and able to be used year-to-year so that the data can be reported on across multiple camps. There will be more features added during this academic year through more senior design groups. The registration system can be accessed by clicking the "Register" link at the top-right corner of http://summercamps.usc.edu.

The camps ran for one week each over five weeks from July 5 through August 5, 2016. Parents applied starting on March 1 and were notified of acceptance by May 1. Parents then had to confirm that their kids would be attending within seven days of acceptance. If they did not confirm, the student was moved to the wait list for that camp, and another child was accepted. This process continued until the maximum number of students were confirmed for each camp.

The dates, levels, topics, and recommended grade levels of each free camp that were offered this summer are as follows. There were multiple paid camps offered each week as well, though I have not listed those.

Dates	Camp Level	Camp Topic	Recommended Grade Level	# Students Attended
July 5-8, 2016	Beginning	Scratch	Fullerton 4th-6th	60
July 11-15, 2016	Beginning	Scratch	4th-6th	23
July 11-15, 2016	Beginning	Scratch	6th-8th	23
July 11-15, 2016	Beginning	Scratch	Fullerton 4th-6th	58
July 18-22, 2016	Intermediate	Scratch	6th-8th	24
July 18-22, 2016	Beginning	Scratch	Fullerton 6th-8th	56
July 18-22, 2016	Beginning	Python	6th-9th	23
July 18-22, 2016	Beginning	Scratch	MESA 5th-7th	32
July 25-29, 2016	Beginning	Scratch	4th-6th	20
July 25-29, 2016	Beginning	Scratch	6th-8th	18
July 25-29, 2016	Beginning	Scratch	Fullerton 6th-8th	53
August 1-5, 2016	Beginning	Scratch	4th-6th	30
August 1-5, 2016	Intermediate	Scratch	6th-8th	24

Each of the Fullerton camps had 60 students accepted. The MESA camp had 32 students accepted, and the rest of the camps had between 25-30 students accepted to them. This provided for a total of 444 students to attend the CS@SC camps for free in 2016.

The MESA program exposes K12 students to STEM topics throughout the school year and summer, culminating in a two-week summer camp program. The MESA organizers at USC partnered with the CS@SC Summer Camps to provide their students with computer science education for the first week and other engineering disciplines during the second week.

The Fullerton School District sent their students on a bus from Fullerton to USC each day of the camp (approximately 30 miles), along with four teachers each week. The teachers attended the camps to learn the material and help with classroom management. During the school year, the CS@SC Summer Camps will provide support to the teachers if they would like to incorporate programming into their classes.

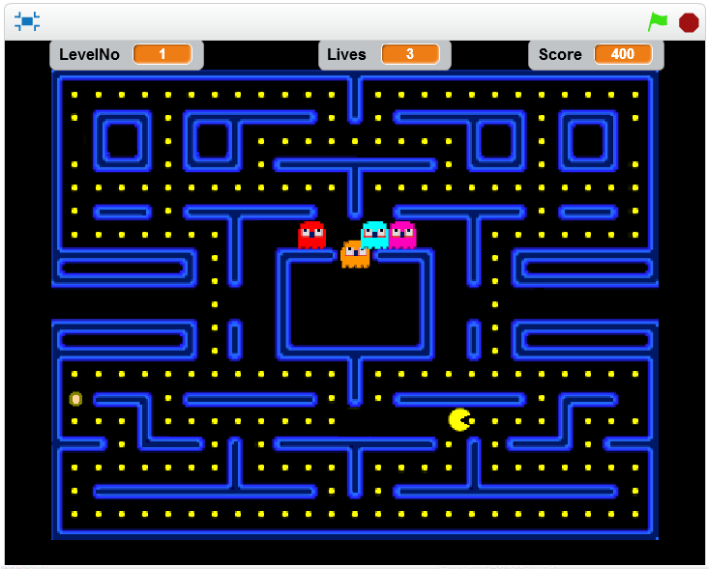
The camps ran from 8:00a.m.-3:00p.m. Monday through Friday each week, with the exception of Monday, July 4, 2016. There was a brief introduction each morning that had a brain teaser to help the students begin thinking about the sequence of steps used to solve a problem (known as an algorithm). Students were then dismissed to their respective camps where they began learning new material and working on different programs. There was a break from 10:00-10:15a.m. each morning, lunch from 12:00-1:00p.m., and a break from 2:00-2:15p.m. each afternoon.

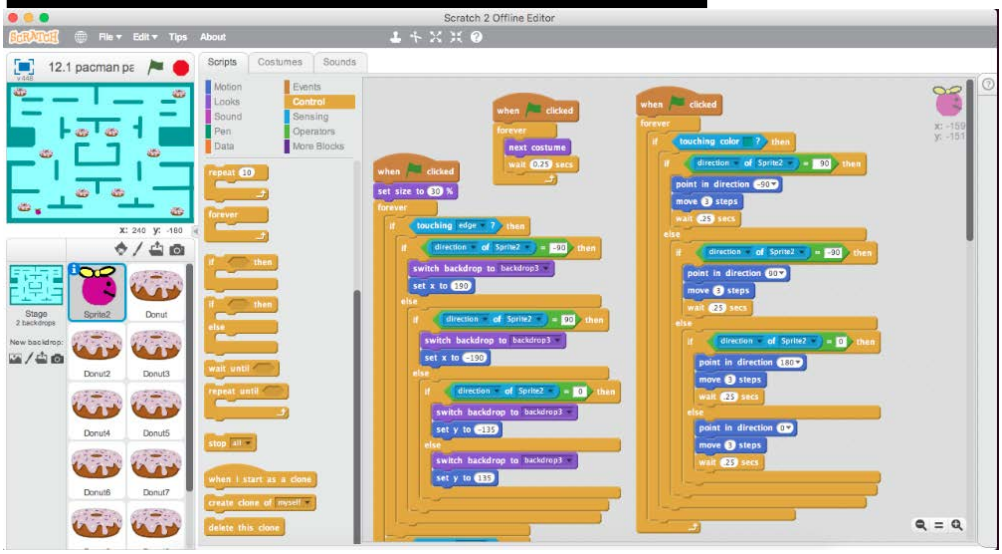
There was an orientation for parents on Monday mornings from 8:00-8:45a.m. to provide them with an overview of the goals of the camp, locations of the camps, logistics for drop off and pick up, and answer any questions they may have had. On Friday, parents were invited to join the camps for lunch and the afternoon events to see what their kids had accomplished. The students all received a t-shirt and a USB drive that contained all of the programs they wrote that week. In addition, Raytheon provided backpacks and Github provided stickers for all of the students.

Raytheon and the Institute for Education sent representatives to the camps to talk with the students about what their respective organizations do, and the representatives then accompanied the students to the camps to see what they were doing.

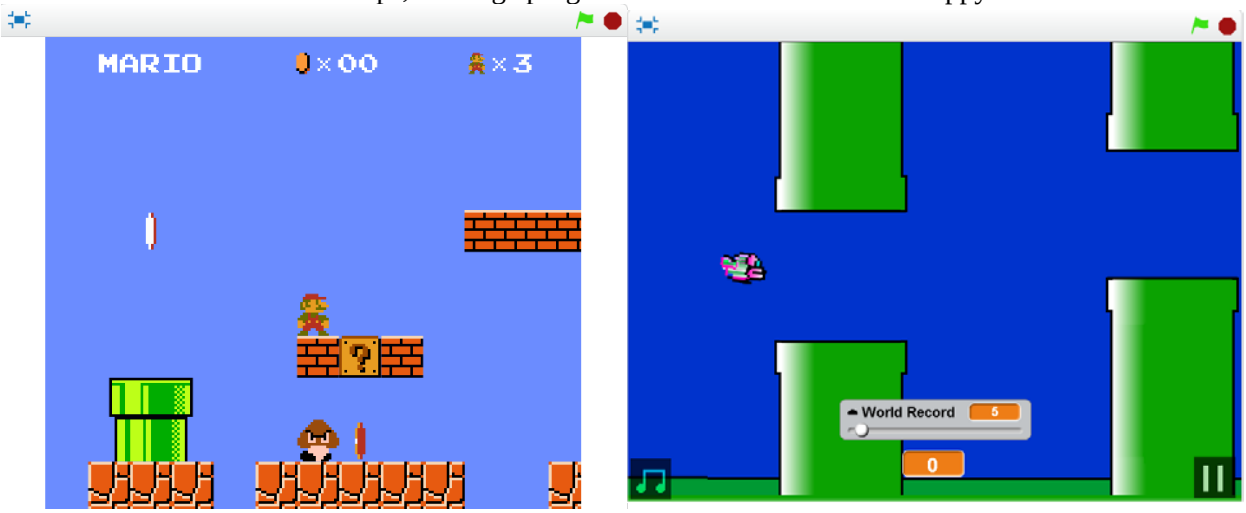
The curriculum makes use of a three-step process where the TAs teach a topic, write a program with the students to show them an example using the topic, then have the students write a program on their own to reinforce the topic. There is one program that is built on throughout the week to allow the students to create a large program with much more functionality than a smaller program would have.

In the Beginning Scratch camps, the large program was Pacman. A small portion of the logic is shown below as well.



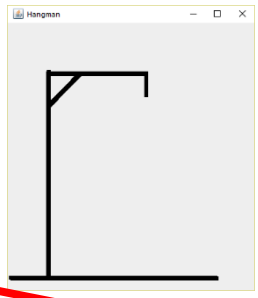
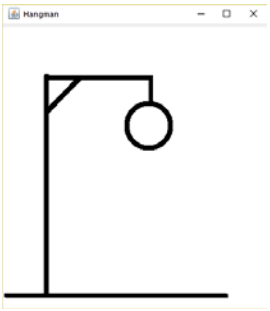
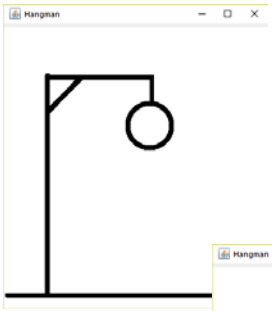
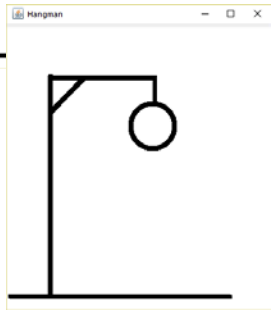
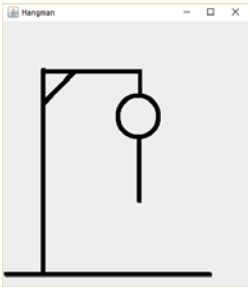


In the Intermediate Scratch camps, the large programs were Mario Bros. and Flappy Birds.



In the Java and Python camps, the large programs were Hangman and Battleship. Here is a sample execution of Hangman, which used the command line and a Graphical User Interface.

```
Welcome to Hangman!

Word to Guess: _ _ _ _ _

Enter a letter: q
q is NOT in the secret word.
That is incorrect guess #1.

Word to Guess: _ _ _ _ _

Enter a letter: m
m IS in the secret word at index 2.
m IS in the secret word at index 3.

Word to Guess: _ _ m m _

Enter a letter: y
y IS in the secret word at index 4.

Word to Guess: _ _ m m y

Enter a letter: l
l is NOT in the secret word.
That is incorrect guess #2.

Word to Guess: _ _ m m y

[the game continues]
```

Here is a sample execution of Battleship that ran from the command line.

```
Enter the name of the board configuration file: battleship.txt

Reading configuration file...
Ready to play!

Current Board
  0 1 2 3 4 5 6 7 8 9
0 0 0 0 0 0 0 0 0 0
1 0 0 0 0 0 0 0 0 0
2 0 0 0 0 0 0 0 0 0
3 0 0 0 0 0 0 0 0 0
4 0 0 0 0 0 0 0 0 0
5 0 0 0 0 0 0 0 0 0
6 0 0 0 0 0 0 0 0 0
7 0 0 0 0 0 0 0 0 0
8 0 0 0 0 0 0 0 0 0
9 0 0 0 0 0 0 0 0 0

Enter column: 8
Enter row: 1

That is a hit!

Current Board
  0 1 2 3 4 5 6 7 8 9
0 0 0 0 0 0 0 0 0 0
1 0 0 0 0 0 0 0 * 0
2 0 0 0 0 0 0 0 0 0
3 0 0 0 0 0 0 0 0 0
4 0 0 0 0 0 0 0 0 0
5 0 0 0 0 0 0 0 0 0
6 0 0 0 0 0 0 0 0 0
7 0 0 0 0 0 0 0 0 0
8 0 0 0 0 0 0 0 0 0
9 0 0 0 0 0 0 0 0 0

Enter column: 8
Enter row: 0

That is a miss.

Current Board
  0 1 2 3 4 5 6 7 8 9
0 0 0 0 0 0 0 0 X 0
1 0 0 0 0 0 0 0 * 0
2 0 0 0 0 0 0 0 0 0
3 0 0 0 0 0 0 0 0 0
4 0 0 0 0 0 0 0 0 0
5 0 0 0 0 0 0 0 0 0
6 0 0 0 0 0 0 0 0 0
7 0 0 0 0 0 0 0 0 0
```

```
8 0 0 0 0 0 0 0 0 0 0
9 0 0 0 0 0 0 0 0 0 0

<game continues>
<assume user guessed all the right locations the rest of the time>

Enter column: 9
Enter row: 7

That is a hit!

Current Board
  0 1 2 3 4 5 6 7 8 9
0 0 0 0 0 0 0 0 0 X 0
1 * * 0 0 0 0 0 0 * 0
2 0 0 0 0 * 0 0 0 * 0
3 0 0 0 0 * 0 0 0 * 0
4 0 0 0 0 * 0 0 0 * 0
5 0 0 0 0 0 0 0 0 * 0
6 * * * * 0 0 0 0 0 0
7 0 0 0 0 0 0 0 0 * *
8 0 0 0 0 0 0 0 0 0 0
9 0 0 0 0 0 0 0 0 0 0

You sunk all of the ships in 17 guesses!
```

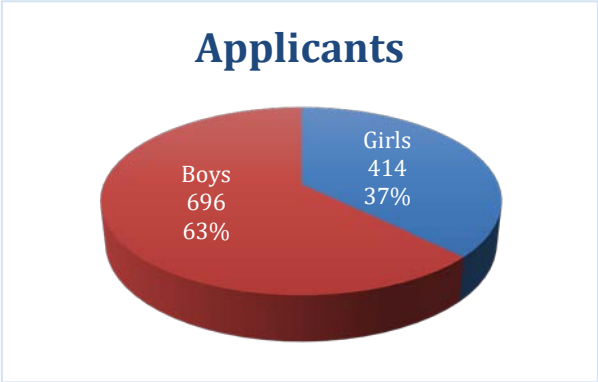
2016 Camp Demographics

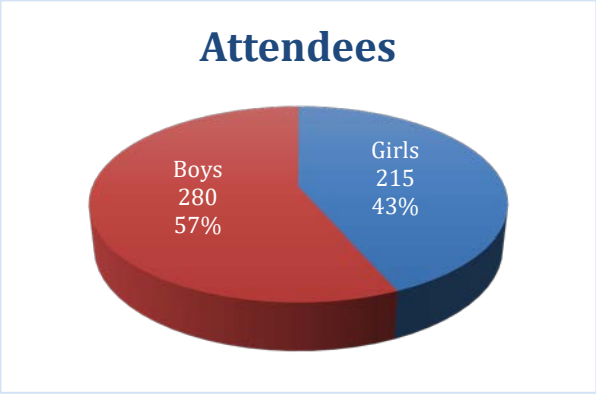
In 2015, there were over 500 students who applied for the 200 spaces, and in 2016, there were 1,110 applicants who applied for 255 spaces. The advertising in 2016 for the camps consisted of the following:

- Email blast to all applicants from 2015
- Email the university liaisons at the 15 USC Family of Schools (https://communities.usc.edu/family-of-schools/)
- Web site with information about the camps, including a new custom registration system (http://summercamps.usc.edu)

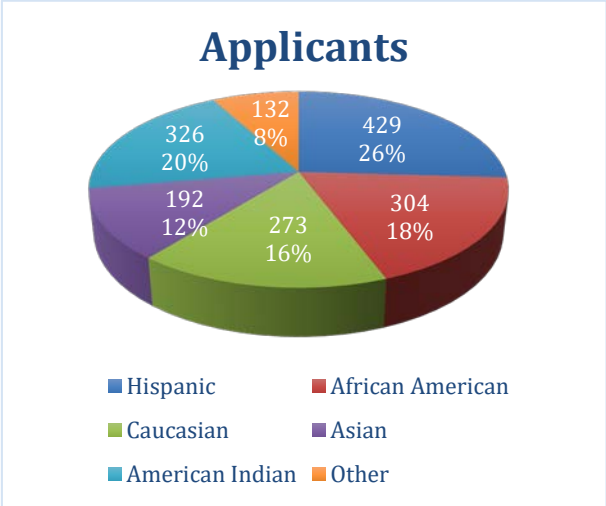
The Fullerton School District handled application and registration of students from their own school district, though they were in agreement of the goals of the camp. Of the 1,110 students who applied (not including the 227 students from the Fullerton School District), 63% of them were boys and 37% were girls. The 495 attendees consisted of 57% boys and 43% girls, which is more than twice the national average for female graduates majoring in science, technology, engineering, and mathematics (STEM) fields, currently at 18.6% (http://www.nsf.gov/statistics/2015/nsf15311/tables/pdf/tab2-10.pdf).

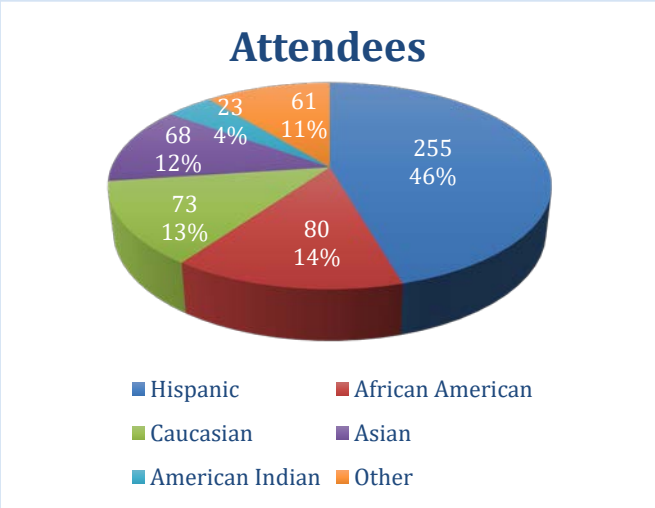
To show the demographics of the camps, the following charts provide the statistics of the applicants and attendees. The gender of the applicants and attendees are shown in the following charts.





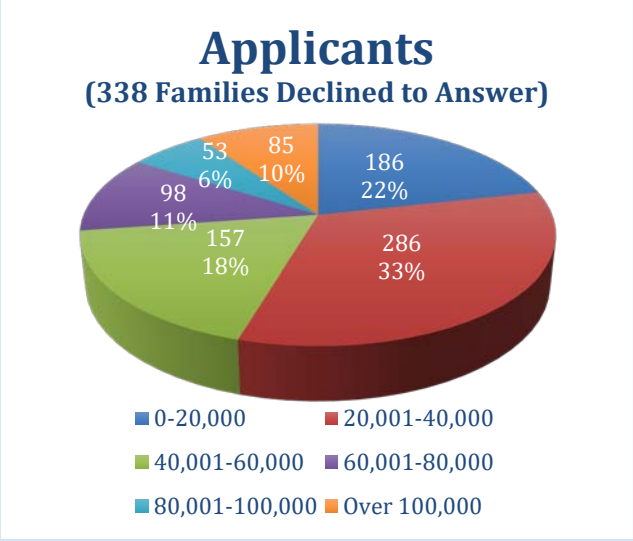
The ethnicities of the applicants and attendees are shown in the following charts. Parents were able to specify more than one ethnicity for the children, and all ethnicities are specified are represented.

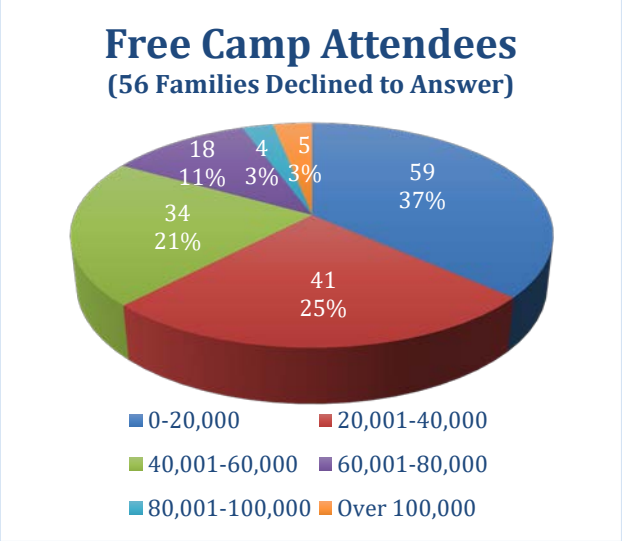




One important note from the ethnicities of the attendees is that 64% of the attendees were from minority ethnicities, specifically Hispanic (46%), African American (14%), and American Indian (4%). Parents stated "Other" as ethnicity for an additional 11% of the students.

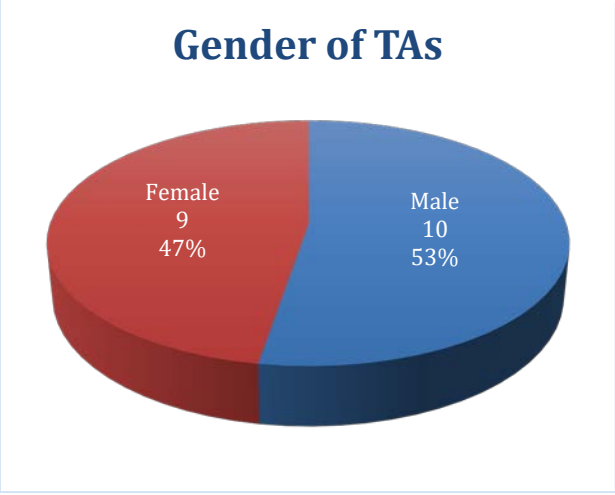
The self-reported annual family income of all applicants and the attendees of the free camps are shown in the following charts. Note that the Fullerton School District did not provide family income for their students.

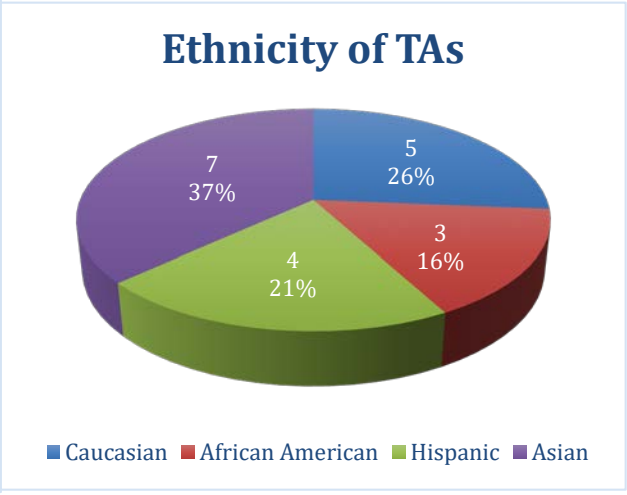




Although one of the goals of the summer camps is to provide computer science education to low income families, diversity is extremely important to provide a more realistic view of the field. Even though 83% of the parents of attendees reported a family income of under $60,000, we did accept 17% of students with income over $60,000. Another 56 families (25%) declined to answer.

Studies have shown that students who have mentors with similar demographics to them are more likely to stay interested in STEM fields (https://www.aaas.org/news/mentoring-key-increasing-minority-and-women-s-participation-stem-education-researchers-say). The genders and ethnicities of the TAs for the 2016 camps are below.





The CS@SC staff took one evening to go to a Dodgers game.

And fortunately…

And here are some pictures of the TAs during the camp.

In addition, I piloted a program this summer of having students who attended higher level camps come back to volunteer and help in lower level camps. One of our students who attended the Beginning Scratch camp in 2015, attended a number of events throughout the academic year in 2015-2016, and attended the Intermediate Scratch camp in 2016 helped us for two weeks. She is going into 4th grade and did an incredible job. The feedback from my TAs was overwhelmingly positive, and I would like to expand this program in the future.

At the end of all the camps, I asked all of the TAs to fill out an anonymous survey to provide me feedback on their experiences. The feedback was overwhelmingly positive. Here are a few comments from them.

> *CS@SC was definitely beneficial beyond mere monetary gain. In terms of personal growth, I feel that my leadership skills were tested in ways I did not expect. I've worked with younger kids before in a more intimate one-on-one setting so I thought I knew going in how to deal with younger kids. However, leading a class of at least 20 students was an entirely different experience. As the weeks progressed I think I learned how to better manage and motivate groups of people, how to deal with a wide array of different personalities and learning paces, and how to think quickly to accommodate the needs of individual students such that both the individual and the group benefited. I also became more comfortable speaking publicly and I solidified my understanding of basic CS concepts by deconstructing them in a way elementary and middle school students could grasp.*

> *This was an amazing experience given to me and I would like to thank you a lot Professor Miller. Apart from being paid, it was fun interacting with the kids. A good experience on understanding how things can be made easier for kids to understand. A good exposure on how academia can be like. An opportunity to interact with other TAs from different backgrounds.*

I got to remember how much I liked working with kids, and also having to break down concepts to them forced me to think about code differently. Forming relationships with both the students, other TAs, and you (professor) was a nice bonus. I definitely made a lot of friends. Plus, I feel like I have in some part made a real difference in these kids' lives, especially because diversity in tech is a subject personally important to me.

I think it was one of my best computer science experiences at USC, working on bringing down coding to a level easy for kids to understand was a good challenge, definitely a little more complicated than expected. It made me appreciate more my opportunity at USC and the knowledge I have acquired and inspired me to always being willing to share and help other with the same knowledge. When I get a job one day, I want to feel good by the end of the day because my work is helping people and not because of the amount of money that is going into my back account.

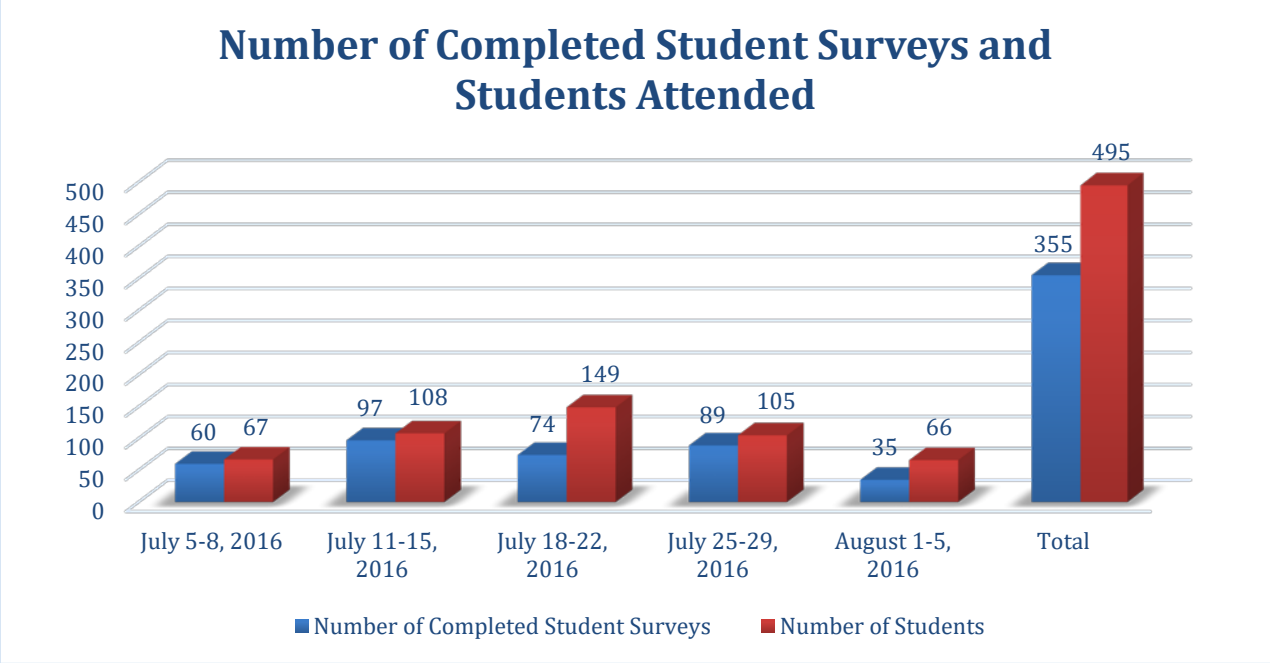
I've always enjoyed teaching and it's honestly really wonderful to see these kids light up with understanding in our classes. It's great to be able to feel like I'm inspiring the same passion that I feel for CS in my students. Even if it's only for a few weeks with a few students at a time, it's nice to feel like I'm giving back to my community, even in just a small way.

It was great experience working with kids. I learned to explain some technical jargon terms in a really simple manner so that they understand. I also learned many things from Professor Miller like showing up every day with smile and same energy level, controlling the classroom, constantly checking if things were in line.

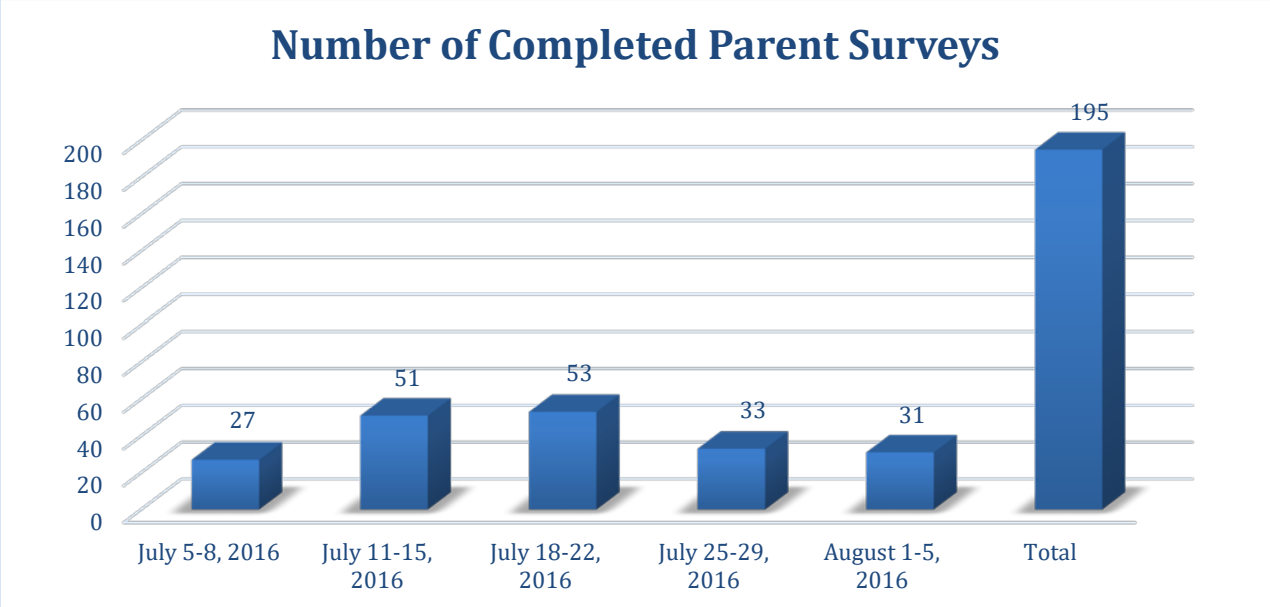
2016 Survey Results

At the end of each week's camp, the students are given the survey provided in Appendix A. In addition, parents are invited on Friday afternoons to join the camps for lunch, to see what their kids have done, and for a closing ceremony. During this period, parents are given the survey provided in Appendix B. A summary of those surveys are provided in the following charts.

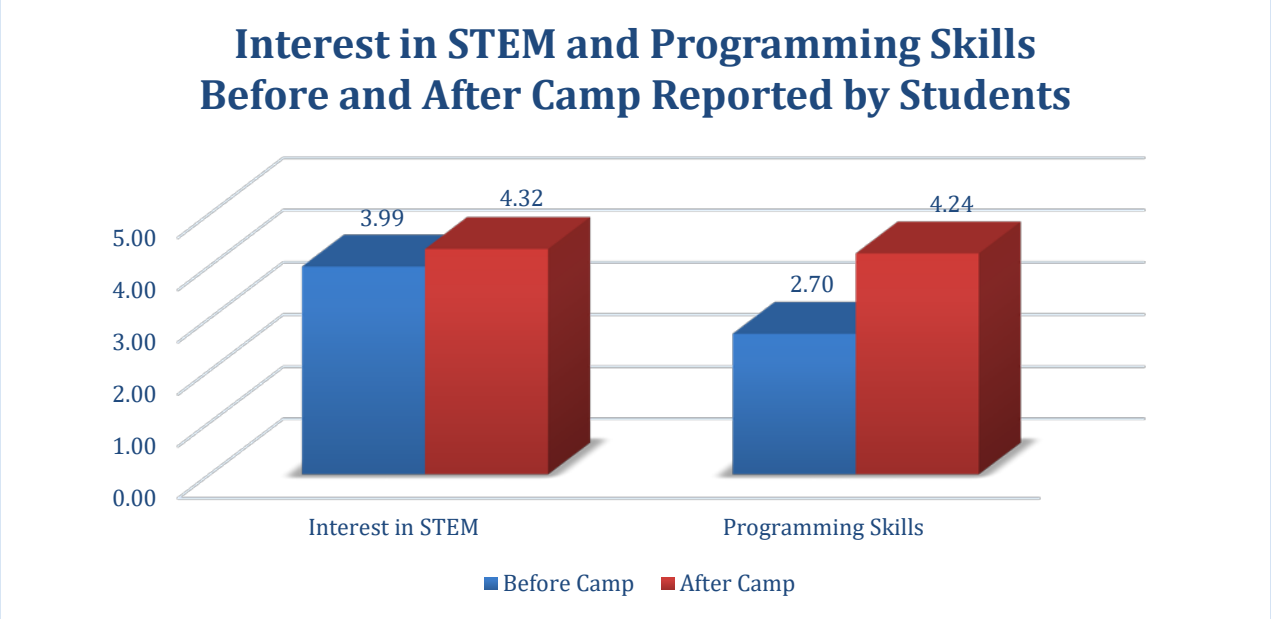
The number of students who attended the camps and completed the survey each week is provided below.



The number of parents who completed the survey on Friday afternoon when attending the afternoon session is provided below.

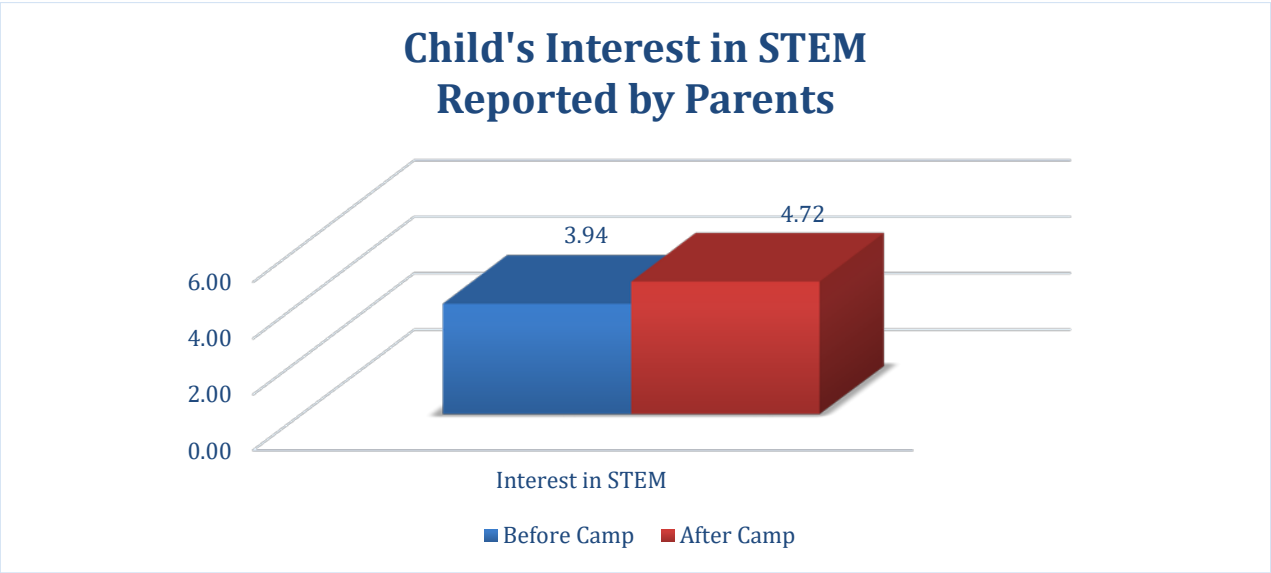


Students were asked about their interest in STEM and their programming skills before and after the camp. The results are as follows.



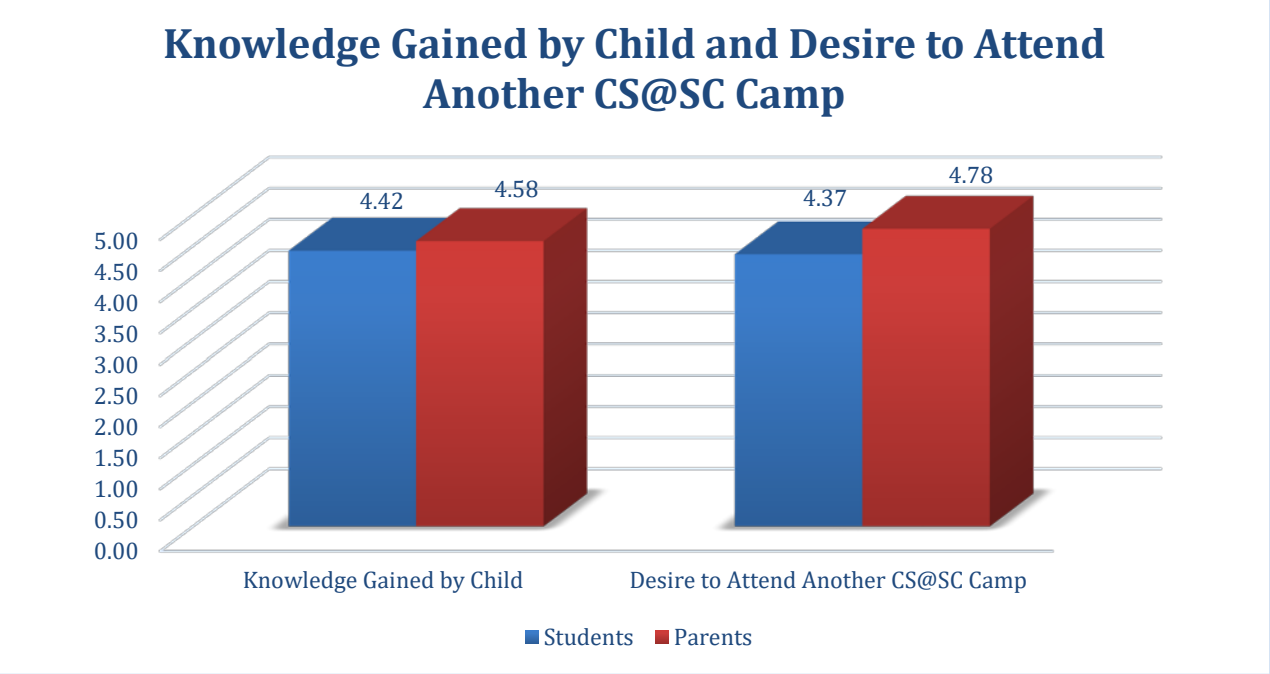
Although the students self-reported that they were already interested in STEM before the camps started (3.99/5.00), their interest in STEM did improve by the end of the week (4.32/5.00, which is 0.33/5.00 or 6%). Their programming skills, on the other hand, increased from 2.70/5.00 to 4.24/5.00, which is a 1.54/5.00 (31%) improvement.

Parents were asked about their children's interests in STEM before and after the camp, and the results are depicted below.



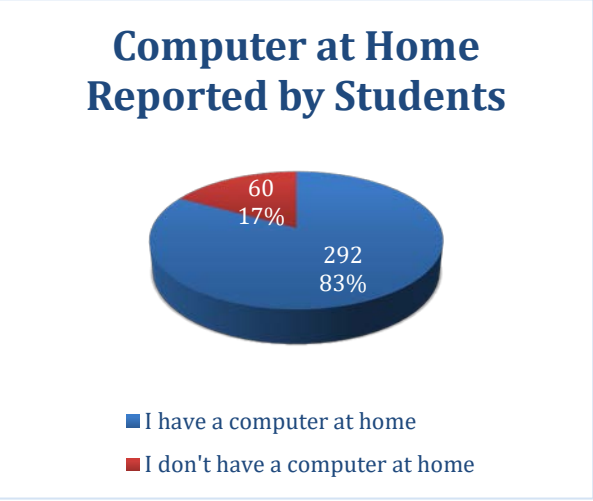
Parents reported consistently with that of the children for STEM interest before the camp (3.99/5.00 from the kids and 3.94/5.00 from the parents), but the STEM interest after the camp went to 4.72/5.00, an increase of 35%.

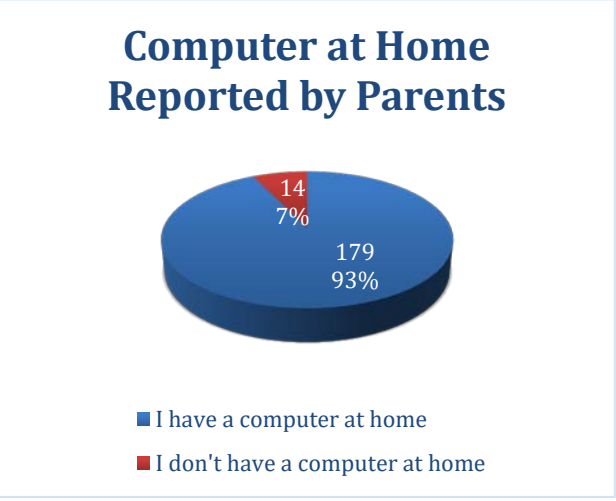
Students and parents were asked how much the students learned during the camp and their desire to attend another CS@SC camp. The results are below.



Students believed they learned 4.42/5.00 (88%) during the camps, and parents believed their kids learned 4.58/5.00 (92%). Concerning the desire to attend another CS@SC camp, 4.37/5.00 (87%) was the average from the students and 4.78/5.00 (96%) was the average from the parents. That shows an overwhelmingly positive response to the camps.

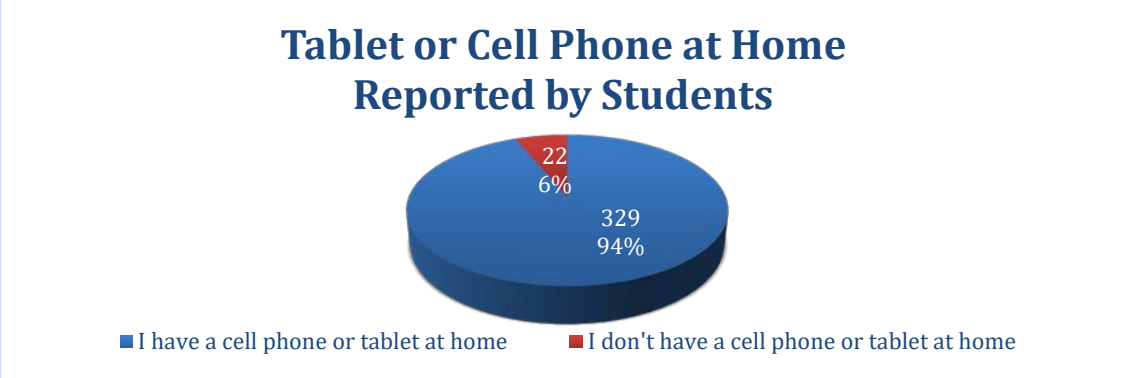
Students and parents were asked if the kids had a computer at home to use. The results are as follows.



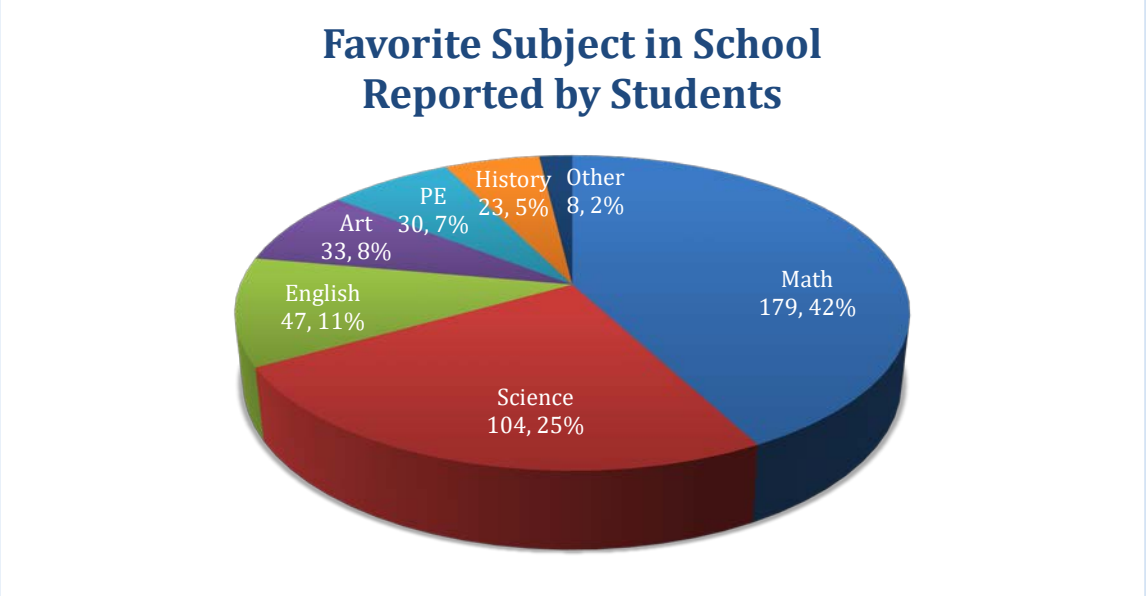


The students reported that 83% of them have a computer at home to use. Parents reported that 93% of them have a computer at home to use. One reason for the discrepancy could be based on the parents who attended the Friday afternoon camp activities not being completely representative of the kids who attended the camps. Since 62% of the attendees come from families with self-reported annual income of under $40,000, it is quite likely that some parents who cannot afford a computer were unable to take the time off work or make it to camps for these activities.

Interesting though is that 94% of the students reported that they have a tablet or cell phone at home to use, as shown in the following chart. This shows that regardless of family income, a cell phone or tablet is more of a priority than a computer.

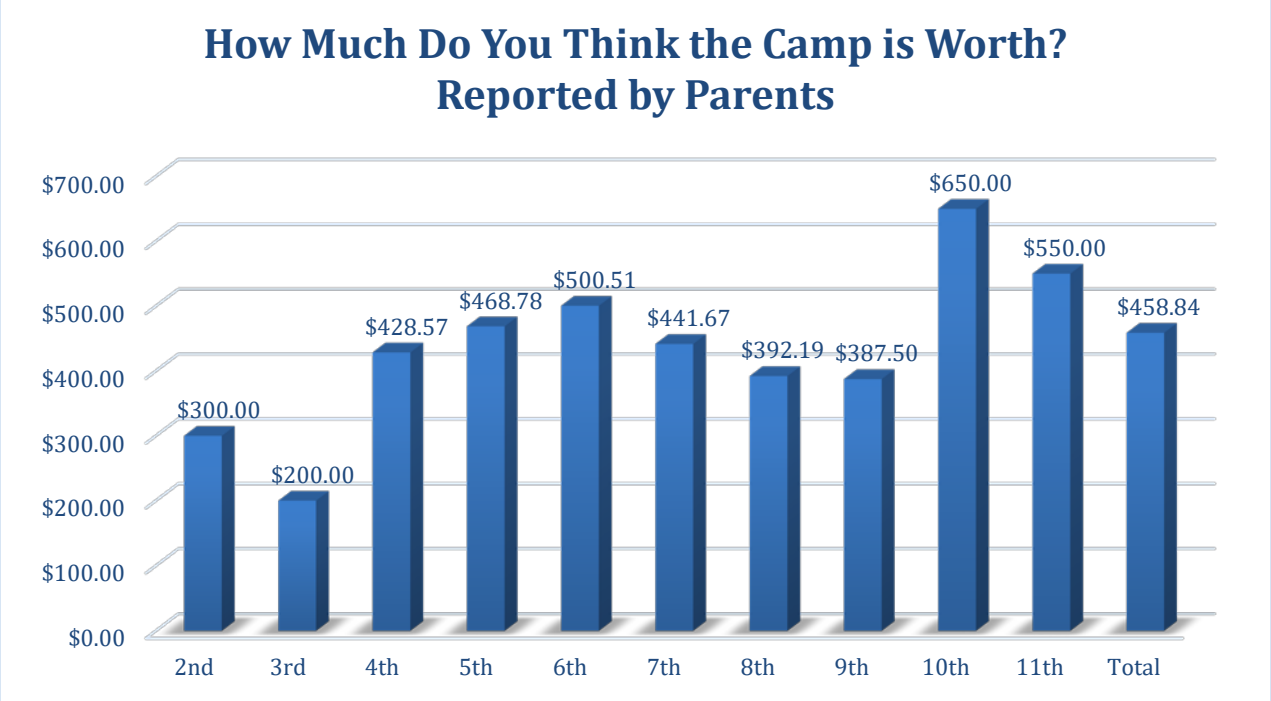


Students were asked about their favorite subject in school. Most students only included one subject, but a fair number included more than one subject. All of the subjects listed were included in the analysis. The chart below depicts the results.



Over 67% of the students who attended the summer camps expressed a favorite subject of math or science. That leaves 33% of the students who stated English, art, physical education, history, or another subject as their favorite. It is important to retain the students who have expressed interest as well as expose the kids who have not expressed interest to computer science.

The parent survey had a question asking parents how much they felt the camp was worth. The responses are depicted in the graph below, separated by grade level of the child.

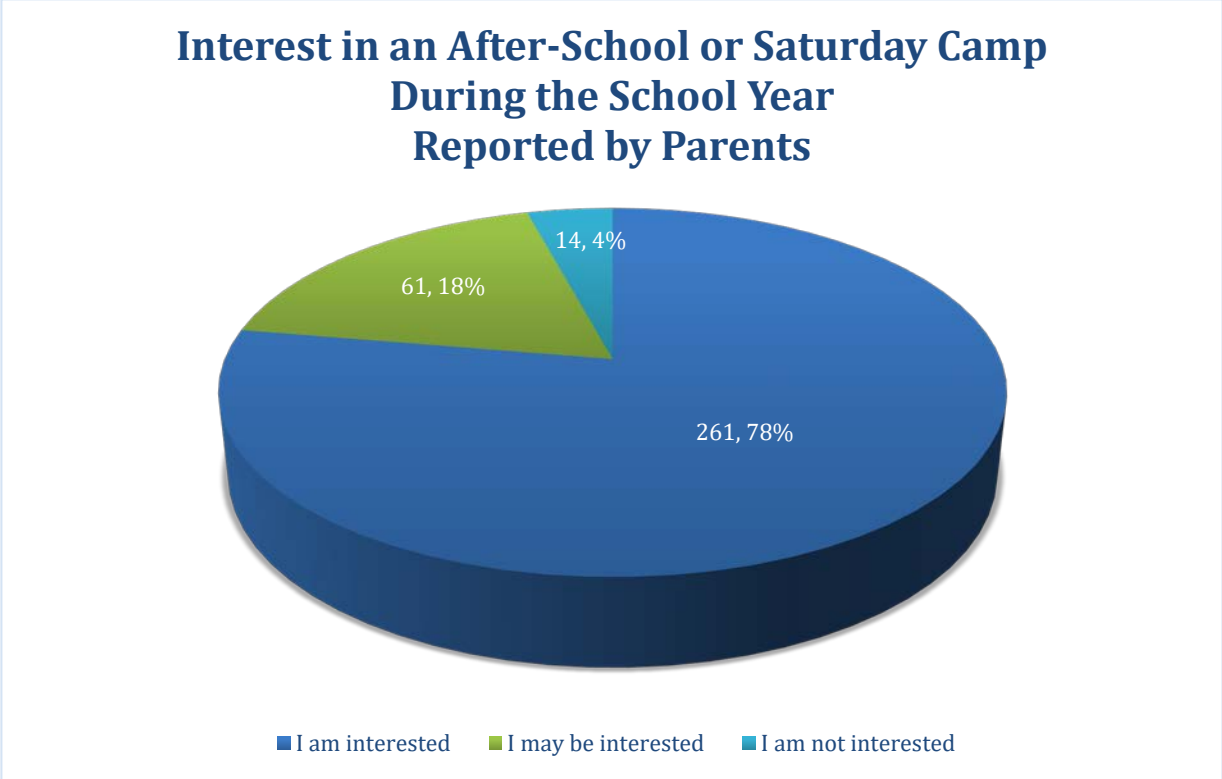


Parents may have known that the paid camps cost $550 for a student to attend for a week, but very few responses were $550. The responses ranged from $50 up to $1,000, and a few people stated "priceless". In addition, there were a number of parents who stated the camp was very valuable but they were not able to afford more than a certain amount. Although the intent of the question was not to see how much parents could afford to pay, it appears that some parents took it in that manner. In short, the average for all of the parents was $458.84, though I believe the actual value of the camp should be higher than that based on the misunderstanding from the parents who provided comments.

Moving Forward

It is important to Coach Kathy Kemper of the Institute for Education and me that continuous engagement is necessary to keep kids interested in programming long-term. Because of that, I am planning to offer after-school or Saturday programs throughout the school year. In addition, there will be a number of free activities on campus at USC for camp applicants to attend, such as Hour of Code in December and a Robotics Open House in April.

In preparation for after-school or Saturday camps, parents were asked if they would be interested in either of those programs. The responses are depicted below.



As can be seen, 96% of the parents stated that they are or may be interested in an after-school or Saturday program similar to what we did during the summer camps.

In addition, it is not too early to begin planning for next summer. The goal for next summer is 10 weeks with 100 kids per week attending free camps. We had five weeks of camps with 444 kids who attended free camps in 2016. That means that we need to more than double the donations we had in 2016 (excluding the personal donations, since the majority of that went to support paid camp students), especially since there will be slightly more administrative work required for scaling the camps to that level. I conservatively estimate that we need to raise at least $250,000 to enable 1,000 kids to attend camps in summer 2017.

Appendix A
Post-Camp Camper Survey 2016

1. Grade in fall 2016 K 1st 2nd 3rd 4th 5th 6th 7th 8th 9th 10th 11th 12th

2. Camp Level Attended Beginner Intermediate Advanced

3. Camp Attended Scratch Java Python Scratch Jr.

4. Are you from Fullerton School District? Yes No

5. Please rank the following aspects of the camp.

	Poor	Okay	Adequate	Good	Outstanding or A Lot
Overall, what did you think about the camp?					
How much did you learn?					
Professionalism of camp staff					
Interest in science, technology, engineering, and mathematics before camp					
Interest in science, technology, engineering, and mathematics after camp					
Your programming skills before the camp					
Your programming skills after the camp					
Attention provided to you by the TAs					
Lunch variety and selection					
Friday afternoon family event					
Desire to attend another CS@SC camp					

6. Do you have a computer or laptop at home you can use? Yes No

7. Do you have a cell phone or tablet at home you can use? Yes No

8. What is your favorite subject in school?

9. What did you like most about the camp?

10. What did you like least about the camp?

11. What do you think we could do better?

Appendix B
Post-Camp Parent Survey 2016

The survey is anonymous and will help us to improve our camps for the future.

12. Child's Grade in fall 2016 K 1st 2nd 3rd 4th 5th 6th 7th 8th 9th 10th 11th 12th
    Are you from the Fullerton School District? Yes No
13. Camp Level Attended Beginner Intermediate Advanced

14. Camp Attended Scratch Java Python Scratch Jr.

15. Please rank the following aspects of the camp.

	Poor	Okay	Adequate	Good	Outstanding
Impression of camp from your child					
Knowledge your child gained					
Professionalism of camp staff					
Child's interest in science, technology, engineering, and mathematics **before** camp					
Child's interest in science, technology, engineering, and mathematics **after** camp					
Attention provided to your child in the camp					
Lunch variety and selection					
Information available on web site					
Ease of applying					
Communication after applying					
Parking					
Monday morning parent meeting					
Ease of drop off					
Ease of pick up					
Friday afternoon parent involvement					
Likelihood of attending another CS@SC camp					

16. How much do you think this camp is worth? $_____/week
17. Is there a computer at home for your child to use? Yes No
18. What do you think we did well?

19. What do you think we could improve?

20. Would you be interested in attending an after-school program like this during the school year?
    Yes No Maybe
21. Would you be interested in attending a Saturday program like this during the school year?
    Yes No Maybe

22. If you may be interested in an after-school or Saturday program during the school year, please rank your preference of location from 1 to 7, with 1 being your most-preferred location.

USC's Main Campus	USC's Health Science Campus	West LA	Inland Empire	San Gabriel Valley	San Fernando Valley	Orange County